

SCHOOL OF CIVIL ENGINEERING



JOINT HIGHWAY  
RESEARCH PROJECT

JHRP-77-20

AN INVESTIGATION OF THE FINAL  
CONSTRUCTION CONTRACT PAYMENT  
PROCEDURE FOR THE INDIANA STATE  
HIGHWAY COMMISSION

David L. Mays



PURDUE  
INDIANA STATE UNIVERSITY  
HIGHWAY COMMISSION



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Final Report

AN INVESTIGATION OF THE FINAL CONSTRUCTION CONTRACT  
PAYMENT PROCEDURE FOR THE INDIANA STATE HIGHWAY COMMISSION

TO: J. F. McLaughlin, Director  
Joint Highway Research Project

FROM: H. L. Michael, Associate Director  
Joint Highway Research Project

November 8, 1977  
Project: C-36-67I  
File: 9-11-9

Attached is the Final Report on the approved JHRP Study titled "An Investigation of the Final Construction Contract Payment Procedure for the Indiana State Highway Commission". The title of the Report is the same. Mr. David L. Mays, Graduate Instructor in Research on our staff, has authored the report and conducted the Study under the direction of Professor Donn Hancher.

The Study objectives of determining the existence of any problems with the procedures and the causes and possible remedies of any problems were achieved. A number of recommendations are included which should be beneficial to ISHC and the State of Indiana. One of these benefits should be a decrease in interest penalties.

The findings have been presented to the management of the ISHC Construction Division for discussion prior to finalization of this report. Comments received were considered in preparation of this final document.

Respectfully submitted,

*Harold L. Michael*

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by

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Project No.: C-36-67I

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## ABSTRACT

Mays, David Lynn. MSCM, Purdue University, December 1977. An Investigation of the Final Construction Contract Payment Procedure for the Indiana State Highway Commission. Major Professor: Dr. Donn E. Hanchar.

Prior to March 1972, several contractors who performed highway related construction work for the State of Indiana complained about the State's slowness in making final retainerage payments. These complaints resulted in a law being passed by the Indiana General Assembly which required the State of Indiana to pay an interest penalty to the contractor if the final payment was not made within 180 days of contract acceptance. Indiana State Highway Commission (ISHC) officials believed that this law would benefit the contractor through faster retainerage payments, and at the same time motivate its project engineers to submit all of the required paperwork for their completed projects so that this 180 day target date could be met. However, it was quickly discovered that this law did not accomplish these objectives. In every year since interest penalties began occurring, the total amount of interest penalties paid to the contractor has increased. Therefore, ISHC officials felt that research was needed in order to determine how severe the interest penalty problem had become and why the interest penalties continue to occur. The ISHC officials also suggested that the Indiana State Highway Commission 1970 Construction Record Guide for Road, Bridge,



Maintenance, and Traffic Contracts might be a cause of interest penalties in that its up-to-dateness and clarity are sometimes questioned.

In order to answer these questions, the researchers first had to determine the components of the final construction contract payment procedure and who participated in each. This was accomplished by interviewing three types of ISHC personnel-- District Review Officers, project engineers, and personnel at the Division of Materials and Tests. Each group provided suggestions on how to improve the procedure and expressed opinions on why the present problems exist. The use of the Construction Record was also investigated in the interviews with District Review Officers and project engineers. Finally, the severity of the interest penalty problem was determined by a computer analysis of contract data from 1972 through August 31, 1977.

The research showed that the interest penalty problem is caused primarily by the project engineers and the Division of Materials and Tests' personnel. The project engineers have been turning in the required documentation (the Construction Record) late in the 180 day time period which gives the members of the later components of the procedure less time to complete their duties. The Division of Materials and Tests has had trouble issuing its material certification within the 180 day limit due to organizational problems. The computer analysis showed that interest penalties steadily climbed from \$0.00 in 1972 to a projected \$43,789.86 in 1977.



Finally, the research produced several recommendations to improve the final construction contract payment procedure and thereby decrease interest penalties. Improvements to the Indiana State Highway Commission 1970 Construction Record Guide for Road, Bridge, Maintenance, and Traffic Contracts are also proposed as a result of the research.



## CHAPTER 1

### INTRODUCTION

From the contractor's point of view, the most important aspect of a construction job is being paid what is due him by the owner. Prior to March 1972, several of the contractors in Indiana who performed work for the State felt that the State was much too slow on the final retainage payment. Their opinions prompted the Indiana legislature to pass a law requiring the State to pay the contractor a penalty if final retainage payment was not carried out within a certain period of time after contract acceptance. In the years following the enactment of this law, State highway officials have noticed that they are still having trouble paying the contracts on time and this problem has gotten worse each of the last three years in terms of total penalty dollars. It was then decided that a review of the final construction contract payment procedure was needed in order to point out those areas which are causing the penalty payment problems. Therefore, it is the purpose of this paper to investigate the present contract payment procedure and to propose to the Indiana State Highway Commission changes in the procedure that will increase its efficiency, along with decreasing the amount of money that the State has to pay to contractors each year in penalties for late final retainage payments.



### 1.1 Justification for the Study

An underlying purpose of every local, state, and national governmental agency is to perform its assigned functions at the lowest possible price while at the same time getting the highest quality work possible. The Indiana State Highway Commission strives to accomplish the goal behind this policy but it sometimes runs into problem areas. At present, the final construction contract payment procedure is such a problem area. To justify this statement, a short history of the problem will be presented which should help to prove the need for a study of this aspect of the Indiana State Highway Commission's activities.

The State of Indiana utilizes the Unit Price Contract system for most of its highway work. This system is excellent for both heavy construction and highway construction because of its flexibility. In highway construction, it is very difficult to determine in advance the exact quantities of work to be accomplished by the contract, such as the amount of excavation or fill required. Unexpected situations can develop throughout a project that can change the estimated quantities. The Unit Price Contract centers around these estimated quantities. The owner of the project ( the State of Indiana in our case ) makes an estimate of the quantities of work for each activity or work item of a given job. These estimates are in terms of units of work which correspond to the type of activity, such as cubic yards for backfill. The contractors who desire to perform the work for the State of Indiana then submit a bid in terms of a price per unit of work. This unit price includes the estimated costs of the



material, labor, and equipment needed for the activity plus the profit and overhead for the contractor. This way of contracting in terms of units of work allows for easy calculation of additions to or subtractions from the estimated quantity of work for each job activity.

The overall Unit Price Contract system for the State of Indiana follows a certain procedure. After the bids have been received from the contractors, the unit prices of each bid are checked by a computer for gross variation from the norm and unbalancing of the bid. The contract is awarded to the lowest qualified bidder. Work begins and as it progresses, the contractor is entitled to periodic payments for work already completed. The project engineer of the contract estimates how many units of each work item have been completed by the contractor during the payment period. These quantities are multiplied by the unit price of each and are summed to arrive at the allowable progress payment. However, a portion of this progress payment, usually 5-10 per cent, is retained by the State of Indiana to protect it from poor work, contract violations by the contractor, minor claims for materials, and other contract related problems. This progress payment procedure is repeated throughout the duration of the project.

When the contractor completes his contractual work and an Indiana State Highway Commission official gives it a favorable inspection, the contractor is relieved of further maintenance and the project engineer is required to prepare a final estimate of both quantities and costs for the project. The State of Indiana then follows its final construction contract payment procedure to determine



the final dollar amount due the contractor, including the money retained during each progress payment period. This procedure will be discussed later in detail but it will suffice to say here that it includes the checking by the District Review Officer of the project documents as computed and compiled by the project engineer, material certifications for all materials required by the contract by both the District Office Materials' Laboratory and the Division of Materials and Tests, and the contractor's agreement that the final quantities are what he put in place. This final dollar amount due the contractor can change from that expected based on the initial contract amount. The final amount the contractor receives can decrease due to liquidated damages where a contractor completes the contract late, actual quantities in place being lower than those originally estimated, or mistakes in the State's favor on prior progress payments. Conversely, the final amount the contractor receives can be an increase over what was originally estimated due to actual quantities in place being higher than originally estimated, extra work items, mistakes in the contractor's favor on prior progress payments, or penalties levied against the State because it did not complete its final construction contract payment procedure on time. This last item provides the basis for this study.

Prior to March 1972, several contractors who performed work for the State complained that it was taking an unreasonable and costly length of time for them to receive their final payment from the State of Indiana for a contract including the money retained. This prompted the 1972 Session of the Indiana General Assembly to change



the statutes existing at that time pertaining to the final contract payment on highway related construction contracts performed in Indiana. This new law is found in the Transportation and Public Utilities division of the statutes (8-13-5) and the pertinent quote is in Chapter 5, Section 7 and is as follows:

"Each contract entered into pursuant to the provisions of this chapter shall provide for final payment within one hundred eighty (180) days after acceptance of the project; provided that final payment shall not be so made as to any amount which is in dispute or the subject of a pending claim; and provided further that final payment shall be so made as to that portion of a contract or those amounts which are not in dispute or the subject of a pending claim, and such partial payment shall not constitute any bar, admission, estoppel or have any other effect as to those payments in dispute or the subject of a pending claim. For each day after one hundred eighty (180) days, or thirty (30) days after settlement of a claim, the commission shall pay to the contractor a penalty for late payment of money due to the contractor. This penalty shall be computed at the rate of interest of six per cent (6%) per annum on the unpaid balance."

This change in statutes also specifies that this penalty clause is applicable to all highway related construction contracts for which bids were received by the State of Indiana on or after March 1, 1972.

On August 10, 1972, N. W. Steinkamp, the Chief Highway Engineer for the State of Indiana at the time, issued General Letter No. 2-73 which contained a supplemental specification for contracts which discusses the new statute and points out the beginning and ending days of this contract payment procedure period in order to compute possible penalties. This specification is stated as follows:

"Except as otherwise provided herein, final payment will be made to the contractor within 180 days after acceptance of the project. Acceptance shall be considered as the date the contractor is relieved of further maintenance as provided in 107.16 and set out in the final acceptance letter.



If final payment is not made within 180 days of final acceptance, the contractor will be paid interest in the amount of 6% per annum on the unpaid balance or retainage, subject to the following conditions:

The final date for computation of interest will be the date that the final estimate is prepared in the Central Office and mailed to the contractor for his signature.

Interest will not be paid for those days that delay in payment of the final estimate is not directly attributable to the State. Included in this category, but not limited thereto, is the elapsed time used by the contractor to review and approve the final pay quantities, proof of payment of railroad indebtedness, delinquent or supplemental payrolls or material records, or any other reason that is controlling to the final payment and beyond control of the engineer.

Funds retained for claims, or resulting from litigation, or amounts in dispute will not be eligible for payment of interest until 30 days after settlement."

The new statute quoted previously was intended to benefit both the contractors and the State of Indiana. By having this type of law, the contractor is assured either of receiving the final amount due him within 180 days of contract acceptance or of acquiring a larger dollar amount after the 180 day deadline due to an interest penalty having to be paid by the State of Indiana. The State of Indiana is benefited in that its personnel know that they have only 180 days to complete the final construction contract payment procedure without penalty. This type of regimen provides for stricter compliance with the law since a disregard for the time limit would cause an unanticipated outlay of funds by the State.

However, it was discovered that the existence of this new statute did not compel the State of Indiana to pay the final amount due the contractor within 180 days of contract acceptance on all of its construction contracts. In fact, contract data shows that the State



of Indiana is getting worse in this respect each year. This can be seen on Table 1 shown below:

TABLE 1

## CONTRACT DATA COMPARISON

<u>Year</u>	<u>Total Penalty Amount Paid During the Year</u>	<u>Percentage of Contracts in Which Penalties Were Paid</u>
1974	\$ 1,327.22	1%
1975	\$17,417.43	14%
1976	\$32,272.57	21%

It can easily be seen that both sets of data are increasing, even though a law is in effect that tries to prevent this.

Therefore, Indiana State Highway Commission officials realized that they still have a problem with the final construction contract payment procedure. This topic surfaced when an advisory committee of both Indiana State Highway Commission officials and Purdue University Civil Engineering personnel met in the Fall of 1976 to discuss possible research topics. It was felt that due to the illustrated data, it would be worth the time and money required to investigate the present construction contract payment procedure and to determine possible problem areas and their solutions. The goal of the State of Indiana is to pay all of its construction contracts within the 180 day allotted time period. It is hoped that through the construction contract payment procedure study of which this paper is a summary, this goal will be closer to realization.



### 1.2 Objectives of the Study

There are three primary objectives to this investigation. All relate to one another and lead to the same result-- a more efficient final construction contract payment procedure. Each will be discussed separately and indications given of its importance to this study.

The first objective is that of investigating the actual final construction contract payment procedure and how it is carried out. How this procedure is supposed to be accomplished will be discussed in Chapter 2 of this paper. However, it should be pointed out that the present procedure makes strong use of the Indiana State Highway Commission 1970 Construction Record Guide for Road, Bridge, Maintenance, and Traffic Contracts. Indiana State Highway Commission officials have expressed the opinion that the way the present construction contract payment procedure is being carried out by State personnel might be causing penalties having to be paid on construction contracts. They feel that there could be inefficiencies in the present system, which when discovered and alleviated, could enable the State of Indiana to complete a higher percentage of its final construction contract payments within the 180 day time limit. This would then result in a smaller total penalty amount being paid by the State of Indiana to contractors during the year. Therefore, a thorough investigation of this final construction contract payment procedure is of utmost importance to this study.

The second objective of this investigation is a complete review of the Indiana State Highway Commission 1970 Construction Record Guide for Road, Bridge, Maintenance, and Traffic Contracts. As can



be seen from the title, it has been seven years since this publication has been updated. This guide is used by the project engineer of each contract to complete the paperwork required for the highway related construction project. It offers to the project engineer a format of computing final pay quantities for each project work item. As was expressed with the final construction contract payment procedure, Indiana State Highway Commission officials feel that this guide could be inhibiting the payment procedure process and could in turn be a primary reason for interest penalties having to be paid to the contractors. Complaints have been expressed also by both project engineers and District Review Officers with respect to inefficiencies caused by this book. Therefore, the content of this guide will be completely researched and will be discussed at length with Indiana State Highway Commission officials around the State of Indiana.

The third and final objective of this study is that of completing a data analysis of all highway related construction contract data since the interest penalty statute was enacted by the Indiana General Assembly in 1972. Contract data is available from the Indiana State Highway Commission Indianapolis office on computer printouts beginning in 1972. Contract data is updated each month as to those contracts still in progress at the end of the month along with those contracts that were completed during the month. A sample of the type of contract data available from the State of Indiana can be seen in the Computer Program Development section (7.1) of this paper. The objective of the data analysis is to point out the problem areas of the final construction contract payment procedure with respect to contract type,



project engineer type, geographic district, and the reasons for the interest penalties. From the compiled data, several graphs and tables will be made to show interest penalty trends. An example of this has already been seen in Table 1 in the Justification for the Study section (1.1) of this paper. This table pointed out that the penalty situation has gotten worse in each of the last three years in the State of Indiana. Therefore, it is hoped that this data analysis will illustrate that there is a construction contract payment procedure problem and where the problem is most critical.

Finally, it should be pointed out that this data analysis will include all contract data from 1972 through August 31, 1977. Since this paper will be completed by late November 1977, the data will be stopped at this August date to enable the researchers to complete a thorough analysis of the data. However, the researchers will point out anticipated 1977 contract data amounts based on the trends shown during the first eight months of the year.

The three objectives of this study have been thoroughly explained in the preceding paragraphs. How they will be carried out and accomplished will be explained in the next section of this paper.

### 1.3 Method of Completing the Research

The final construction contract payment procedure is a type of construction engineering management technique. A process has been devised in which project engineers complete the required paperwork for a highway related construction contract. This paperwork, also known as the Construction Record, is checked by the district office, and then final payment is made to the contractor of the project.



The State of Indiana has 180 days to complete this process after project acceptance. Therefore, it was felt that in order to complete the analysis of the construction contract payment procedure, it would be best to interview those engineering managers directly involved with the process. There are several types of engineering managers associated with the procedure and the method of extracting the required information from each of them will be discussed separately.

The first type of engineering manager involved with the final construction contract payment procedure to be interviewed was the District Review Officer. There are six geographic highway districts which comprise the State of Indiana and each has a District Review Officer. The main jobs of the District Review Officer are to receive a contract's Construction Record from the project engineer, check its content for precise final work item quantities, issue final work item quantity summary sheets to receive the required material certifications, receive the contractor's approval of the final quantities, and issue the completed Construction Record to the Central Office for final payment to the contractor. As can be seen from his job duties, the District Review Officer is one of the key men in the final construction contract payment procedure. Therefore, the researchers traveled to all of the six geographic districts of the State of Indiana, talked individually with the District Review Officers and asked of each the following questions:

- a) How is the final construction contract payment procedure carried out in your district?
- b) In your opinion, what are the main reasons for interest penalties?



- c) Do you notice any differences between the Construction Records of the city, county, and state project engineers?
- d) Do you have enough personnel to complete your required duties?
- e) What are your recommendations on improving the final construction contract payment procedure?
- f) What do you think about the Construction Record Guide?
  - 1) Unnecessary sections?
  - 2) Repetition?
  - 3) Needed sections?
  - 4) Any other changes that could improve the guide?
  - 5) Unnecessary forms?
- g) Do you initiate retainage reductions?

The researcher stressed to each District Review Officer that his opinions would be held in confidence, and that his frankness would lead to a better final construction contract payment procedure.

The six interviews with the individual District Review Officers provided a lot of valuable information and recommendations for improvement of the final construction contract payment procedure. Also, the District Review Officers provided excellent suggestions on improving the Indiana State Highway Commission 1970 Construction Record Guide for Road, Bridge, Maintenance, and Traffic Contracts. The opinions of the District Review Officers on both the final construction contract payment procedure and the Construction Record Guide will be expressed in Chapter 3 of this paper.

The second type of Indiana State Highway Commission personnel interviewed about both the final construction contract payment



procedure and the Construction Record Guide was the project engineer of a contract. The project engineer prepares what is called the Construction Record for a project. In this document, he computes the in-place quantities of all of the work items which make up a contract. He accounts for any Change Orders to the contract or any Extra Work Agreements. He then turns the completed Construction Record over to the District Review Officer. Therefore, it can be said that the project engineer completes the first step of the final construction contract payment procedure.

An underlying reason for interviewing the project engineers was that Indiana State Highway Commission officials felt that they could be part of the problem in not meeting the 180 day deadline. No engineer likes the paperwork required for a job; so it was the feeling of the researchers that by asking various project engineers their opinions of both the final construction contract payment procedure and the Indiana State Highway Commission 1970 Construction Record Guide for Road, Bridge, Maintenance, and Traffic Contracts, ideas could be obtained that could improve the efficiency of both. The project engineers and the District Review Officers work with both of these topics every day and their opinions can far outweigh those of the researchers who see these topics for a much shorter period of time.

The actual interviews of the project engineers were carried out in the Crawfordsville District of Indiana. The researchers traveled to various areas around the district, stopped at a number of jobs, and talked with several project engineers. The researchers



asked questions of the project engineers similar to the listing shown for the District Review Officers. The opinions and recommendations expressed by the project engineers can be found in Chapter 4 of this paper.

The third type of personnel interviewed about the final construction contract payment procedure was a few of the men who work at the Division of Materials and Tests in Indianapolis. This laboratory issues material certifications. From both the initial analysis of the contract data and opinions expressed by Indiana State Highway Commission officials, it quickly surfaced that this laboratory could be a cause of some of the interest penalties. Therefore, the researcher traveled to Indianapolis to discuss with the laboratory personnel how they carry out their aspect of the final construction contract payment procedure. He asked how they issue a material certification and what type of organizational structure the laboratory follows. The results of this interview can be found in Chapter 5 of this paper.

Finally, the researchers used a computer to accomplish their data analysis of past and present highway related construction contract data. How the computer program was written and what it encompasses can be seen in the Computer Program Development section (7.1) of this paper. The actual data compiled and summarized is found in Chapter 7, the Data Analysis chapter.



## CHAPTER 2

## AN EXPLANATION OF THE FINAL CONSTRUCTION CONTRACT PAYMENT PROCEDURE

Since this investigation is centered around the final construction contract payment procedure, an explanation of the process is in order. It should be pointed out that this elucidation of the procedure will list how it is theoretically supposed to be carried out. It was quickly discovered by the researcher in his talks with the District Review Officers that they do not all precisely follow each of the steps about to be shown. Their reasons for variances from the process will be explained in Chapter 3 of this paper, the Results of Interviews with the District Review Officers chapter.

It is felt by the researchers that the best way to illustrate the procedure is to list the steps that are followed to complete the process. Each step will be comprised of what is done in it and who participates in each component of the procedure. The final construction contract payment procedure is as follows:

- 1) COMPLETION OF MATERIAL RECORDS (IT 611)- These forms are prepared monthly throughout the project by the contractor. They are a record of all of the materials received during the month that are included in the finished project. The contractor submits the IT 611's to the project engineer who in turn checks them both for proper quantities and for representation of all items received on the job during the



month. This is necessary because the contractor sometimes computes quantities incorrectly or omits work items. After the Material Record has been checked each month, the project engineer forwards it to his District Review Officer who in turn forwards copies to the District Office Materials' Laboratory and the Division of Materials and Tests.

- 2) COMPLETION OF THE CONSTRUCTION RECORD- This document is prepared by the project engineer and is submitted to the District Office. For each work item of the contract, the project engineer compares the plan quantity with the quantity in place. Overruns and underruns are noted. This data provides the necessary information for the State of Indiana to make contract price adjustments to the originally estimated total contract price.
- 3) DISTRIBUTION OF PRELIMINARY WORK ITEM QUANTITIES- After the Construction Record is received in the District Office, the District Review Officer transfers the as-built work item quantities onto an IC 642 form which is entitled Comparison of Estimates- Original and Final. He issues this form to both the District Office Materials' Laboratory and the Division of Materials and Tests as preliminary contract quantities. They in turn begin checking to see if the quantities of work items shown on the Material Records sent to them previously are equal to or greater than the quantities shown on the IC 642.



4) CHECKING OF THE CONSTRUCTION RECORD IN THE DISTRICT OFFICE-

After sending out the preliminary quantities, the District Review Officer and his subordinates begin a thorough check of the Construction Record. They check to make sure that the project engineer has made no mathematical errors in his work item quantity calculations, that all of the work items in the contract show up in the Construction Record, that the field books are cross referenced with the Construction Record, and that all of the proper forms required by the Construction Record Guide are included in the project engineer's Construction Record.

5) DISTRIBUTION OF THE FINAL WORK ITEM QUANTITIES- After the Construction Record has been checked in the District Office, the District Review Officer then issues an IC 642 form containing final work item quantities to both the District Office Materials' Laboratory and the Division of Materials and Tests. They had begun their comparison of in-place quantities with Material Record quantities using the preliminary IC 642; now, they can complete the procedure using the final IC 642.6) ISSUANCE OF THE DISTRICT OFFICE MATERIAL CERTIFICATION- After it has determined that the in-place work item quantities agree with the Material Record quantities, the District Office Materials' Laboratory issues a District Office Material Certification to the Division of Materials and Tests. The District Office is notified of this also.



7) ISSUANCE OF THE DIVISION OF MATERIALS AND TESTS CERTIFICATION-

After it has satisfactorily completed its check of final IC 642 quantities with Material Record quantities, have made the determination that the required number of sample tests have been taken, and have been notified that the District Office Materials' Laboratory has issued a material certification, the Division of Materials and Tests issues its certification and notifies the District Office of this fact.

8) ISSUANCE OF THE M-39, THE CONTRACTOR'S INSPECTION OF THE FINAL CONSTRUCTION RECORD REPORT- After both of the material certifications have been received in the District Office, the District Office issues a final quantity IC 642 and the M-39 form to the contractor. This is done so the contractor can check to see if he agrees with the in-place quantities along with the final contract total dollar amount. If the contractor agrees with the work item quantities and the total contract amount, he signs the M-39 and returns it to the District Office. If he does not agree, negotiations on the dispute begin.9) TRANSMITTAL OF THE CONSTRUCTION RECORD TO THE CENTRAL OFFICE-

When the M-39 is received signed from the contractor, the complete Construction Record is sent to the Central Office for additional checking and payment approval.

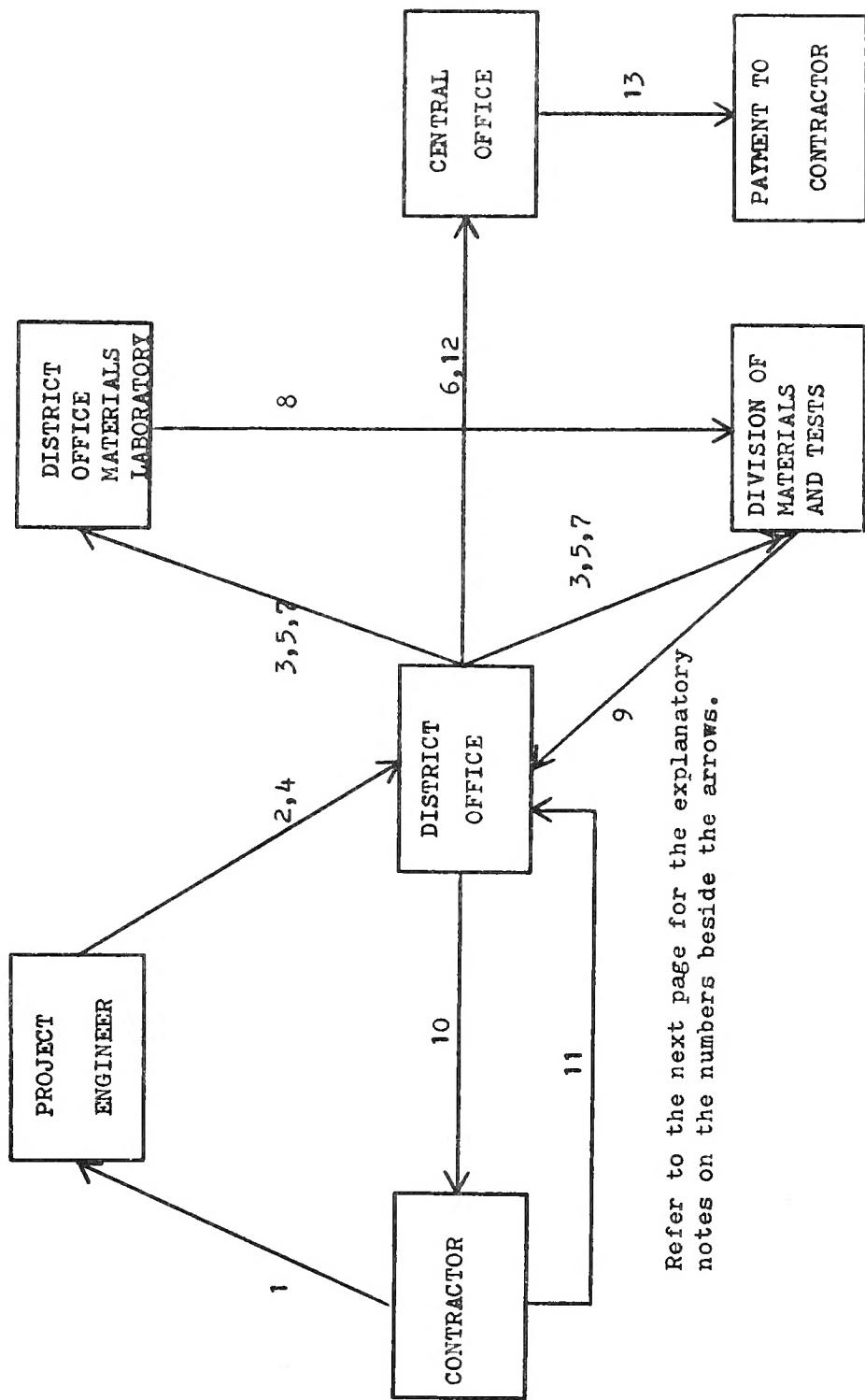
10) PAYMENT TO THE CONTRACTOR- After receiving the Construction Record from the District Office, personnel in the Central



Office check it and if it meets their approval, a check is issued to the contractor for the final amount of money due him.

The final construction contract payment procedure is illustrated in the flowchart shown in Figure 1. The blocks signify persons or places involved in the procedure while the arrows indicate activities between them. The numbers along the arrows are explained on page 21. It should be kept in mind that the procedure explained and shown in the flowchart form is the theoretical procedure. The variations to the final construction contract payment procedure as expressed by the District Review Officers will be shown in the Results of Interviews with the District Review Officers chapter of this paper (Chapter 3).





Refer to the next page for the explanatory notes on the numbers beside the arrows.

Figure 1  
FINAL CONSTRUCTION CONTRACT PAYMENT PROCEDURE FLOWCHART



## EXPLANATORY NOTES FOR THE FINAL CONSTRUCTION CONTRACT

## PAYMENT PROCEDURE FLOWCHART

- 1) Contractor completes and issues a Material Record form (IT 611) each month.
- 2) Project engineer sends in the checked IT 611 each month.
- 3) The district office passes on the IT 611 each month to the testing laboratories.
- 4) Project engineer completes and sends in the Final Construction Record.
- 5) District office issues preliminary work item quantities on an IC 642 form to the testing laboratories.
- 6) District office checks the Final Construction Record.
- 7) District office issues final work item quantities on an IC 642 form to the testing laboratories.
- 8) District Office Material's Laboratory issues their materials' certification to the Division of Materials and Tests.
- 9) Division of Materials and Tests issues their materials' certification.
- 10) District office sends a final quantity IC 642 and an M-39 form to the contractor.
- 11) Contractor sends in the signed M-39.
- 12) District office sends the completed Final Construction Record to the Central Office.
- 13) Central Office checks the Final Construction Record and issues the final payment to the contractor.

Figure 1, cont.



## CHAPTER 3

## RESULTS OF INTERVIEWS WITH THE DISTRICT REVIEW OFFICERS

The researchers traveled to all six State of Indiana highway districts and spoke with the District Review Officer in each district. This man is responsible for reviewing a contract's Construction Record received from the project engineer, checking its content for precise work item quantities, issuing final work item quantity summary sheets to receive the required material certifications, receiving the contractor's approval of the final quantities, and issuing the completed Construction Record to the Central Office for final payment to the contractor. Each District Review Officer was asked a set of questions which were listed in Section 1.3 of this paper. The results of these interviews will be discussed in the following sections, each of which pertains to a certain topic of discussion.

3.1 Final Construction Contract Payment Procedure Flow in the Districts

A discussion of how the final construction contract payment procedure is theoretically supposed to be carried out was made in Chapter 2 of this paper. This procedure was condensed into the flowchart seen in Figure 1 on page 20. Each of the District Review Officers was asked if he followed the theoretical procedure and it was found that not all of them did. In fact, only one of the



districts out of six follows the final construction contract payment procedure step by step. There are two primary deviations to the procedure with three out of six of the districts practicing the first one and two out of six practicing the second. The first deals with preliminary and final quantities on the IC 642 forms. The procedure calls for the District Review Officer to transfer the work item quantities calculated by the project engineer onto an IC 642 and to send these preliminary quantities to both material certification laboratories so they can begin their certifications. The District Review Officers are then supposed to check the Construction Record and the work item quantities within it. They then issue final quantity IC 642's to the laboratories. It was discovered and the researchers concur in this practice that the majority of the districts do not issue preliminary quantities to the certification laboratories. The District Review Officers in these districts stated that it usually only takes them a few days to check a Construction Record. Therefore, they feel that it is unnecessary to issue preliminary quantity IC 642's to the laboratories and then three or four days later issue final quantity IC 642's. However, the districts do realize that if a work item quantity is in dispute or if it takes a long time to check (such as dirt cut and fill), they will issue preliminary quantities to the certification labs in this case.

The second procedural nonconformance deals with the issuance of the M-39 form which is the Contractor's Inspection of the Final Construction Record Report. The theoretical procedure calls for issuance of the form to the contractor after the District Review



Officer receives both material certifications. However, due to many problems dealing with long waits for material certifications, two of the districts send out an M-39 when they have determined what the final work item quantities will be. The researchers feel that this is a bad practice and that these two districts should revert to the specified procedure. Many times, items are left off Material Record forms by the contractors. This changes work item quantities which then change the contract price shown on the M-39. If this happens, a new M-39 has to be sent to the contractor. Therefore, waiting for both material certifications before issuing the M-39 seems to be the most feasible thing to do. It should also be kept in mind that the time spent waiting for the M-39 form to be returned from the contractor is not charged towards the State's 180 day payment period.

### 3.2 Causes of Interest Penalties

All of the six District Review Officers were asked what they thought were the main reasons for interest penalties and each gave essentially the same answers. The two reasons mentioned by all were project engineer paperwork problems, and late issuance of the Division of Materials and Tests certification. As will be seen in Chapter 7, the Data Analysis chapter, the contractual data correlates with the opinions of the District Review Officers. Several men stated that there are certain project engineers in their districts who chronically turn in the Construction Record either wrong, late, or incomplete. They can tell by the project engineer's name on the Construction Record whether they are going to have trouble checking it or not. Also, there are several project engineers in each district who turn



the Construction Records in early and correct almost every time. It seems as though all project engineers should attend periodic workshops on the preparation of Construction Records taught by District Review Officers. This would clarify the mistakes that are made, along with having the project engineers hear suggestions or "tricks of the trade" from their peers.

The late issuance of the Division of Materials and Tests certification also upsets most of the District Review Officers. Few know why this was happening. However, recent changes in the procedure of the Division of Materials and Tests as will be discussed in Chapter 5 of this paper should greatly alleviate this reason for interest penalties.

A few other reasons for interest penalties were stated by the District Review Officers. These included late District Office Materials' Laboratory certifications, variations in the types of project engineers (city, county, or state), the Failure Committee at the Central Office meets only once a month, and that the Central Office requires too many reports (daily, weekly, and monthly). The only one of these of major consequence is the variation of project engineer type. It and another reason will be discussed in the next two sub-sections.

### 3.2.1 Construction Record Versus Type of Project Engineer

The District Review Officers stated that they noticed a great difference between the quality of Construction Records prepared by the state project engineers and those put together by the city or county project engineers. They said that the city and county project engineers make many more mistakes in completing the Construction



Record than do the State of Indiana project engineers. This is probably due to the more experience the state project engineers have in completing a Construction Record. A few of the District Review Officers stated that they find it easier to personally correct many of the mistakes of the city or county project engineers rather than having them come in to correct the Construction Record. It seems to the researchers that the city and county project engineers should also attend the proposed Construction Record workshops taught by the District Review Officers. Experience will not help them if they keep completing the Construction Record incorrectly.

### 3.2.2 District Office Material Certifications

Only one District Review Officer expressed that he sometimes has problems getting District Office Materials' Laboratory certifications. The other five men seemed to have very good rapport with the district testing men and it only takes one to three days to get a certification in these districts. One District Review Officer even expressed the fact the the material's laboratory in his district has agreed to work on those contracts which are late in the 180 day payment period first. This type of cooperation saves the State of Indiana money in interest penalties.

### 3.3 Review Personnel

It was quickly discovered by the researchers that the majority of the districts vary with respect to the personnel completing the final construction contract payment procedure review process. All of the districts obtain extra personnel during the winter months



due to inclement weather making field personnel available for office work. However, during the remainder of the year, two District Review Officers work by themselves in completing the reviewing and checking of the Construction Records. The number of review personnel in the other four districts including the District Review Officer varies from three to six. In the districts which have review personnel besides the District Review Officer, each Construction Record is usually broken down so that the same person checks the same work item categories for each contract. This helps to reduce the number of review errors. However, a few of these districts allow one person to review the entire Construction Record if it is for a small contract. Not one of the District Review Officers stated that he needed more review personnel-- including the two men who work alone. However, the researchers feel that a recommendation is in order here. It seems that something is wrong with the personnel utilization system of the Indiana State Highway Commission when it assigns six review men to one district and only one to another. The amazing fact is that the two districts operating with only a District Review Officer had two of the lowest interest penalty percentages and totals for the 1972 through 1976 contractual data. Therefore, the researchers propose that each District Review Officer should be assigned a field-experienced assistant, and that these two persons should carry out the entire review procedure. This would eliminate unneeded personnel, along with allowing those two District Review Officers without assistants some relief. In view of the fact that fewer highway related contracts are being let due to the near completion of the interstate



system, two review officers should suffice for each district.

#### 3.4 District Review Officer Interaction

All of the District Review Officers expressed the fact that there has been no interaction between them for five to six years. Only two of the six know one another. All said that they would like to have an annual meeting where they could discuss construction contract procedures. It seems as though this would be a very good idea. The six District Review Officers could get together with personnel from the Central Office and discuss general procedures, possible improvements, and problems encountered at the present. Each District Review Officer could state a few of his problems and others of the group who might have already solved the same problems could present their solutions. Another reason for the annual meeting is to prevent gross divergence from contract procedures. At the present, the six District Review Officers are all following their own pathways. These are not too different from the stipulated procedure; however, there is the possibility of ending up with six different payment procedures in the future. The researchers feel that the District Review Officers would be more than willing to participate in such joint meetings.

#### 3.5 Recommendations for Improving the Final Construction Contract

##### Payment Procedure

Most of the District Review Officers discussed the fact of late initiation of needed change orders by the project engineers. A change order is required any time there is a change from the original



plans or estimate which makes the total contract amount increase. The project engineer then documents this change with its anticipated cost on an IC 626 form which is entitled a Recommended Change in Plans, Materials, or Quantities. Two problems have arisen out of the use of this form. First, many project engineers wait until the end of the job to initiate this form, even though the change took place much earlier in the project. This holds up the payment procedure process and the District Review Officers feel that this is mainly due to inexperienced project engineers. Again, an annual workshop for project engineers would help to alleviate this problem. Secondly, some of the District Review Officers say that the project engineers do not complete an IC 626 until they have exact quantities. It is felt that if a change can be foreseen but exact quantities are not known, such as with cut and fill, it would be better to begin the process by turning in an estimated IC 626 so the Indiana State Highway Commission will know it needs extra money for this contract.

Only one District Review Officer did not agree with the policy of working on Construction Records that are late in the 180 day payment period first. Five of them stated that if they are working on other Construction Records and one comes in which is late and which will have a substantial interest penalty if not processed promptly, they will switch their efforts over to this new one. This shows the desire of the District Review Officers of having the lowest penalty amount possible. The sixth District Review Officer brought up the point that looks at things from the contractor's point of view. By working on the late contract first, you save money for the State



of Indiana. However, why should the contractors whose contracts were turned in earlier have to wait for their final payment just so the State of Indiana saves money? The researchers can see this District Review Officer's point, but it should be remembered that he is working for the State of Indiana, not the contractors. Therefore, he is obligated to save as much money for the State of Indiana as he can.

A third recommended improvement deals with retainage reductions. Several of the District Review Officers feel that retainages could be dropped much sooner than they actually are. A dropped retainage saves many dollars in interest penalties. Because of this, when some of the District Review Officers see that the final construction contract payment procedure is running late, they mention to the Construction Engineer of the district that it might be a good idea to lower the percentage retained. Since the contractor has to make the formal request, he is informed that the State of Indiana is willing to make the reduction. No contractor with any common sense will reject this offer; however, the State of Indiana must protect itself before dropping the retainage. If the contract is running late and liquidated damages are due to the State of Indiana, the chances of dropping the retainage are much slimmer. Therefore, the State of Indiana must weigh two evils here-- leave the retainage as it is and pay a higher penalty or drop it and take the chance of not recovering the liquidated damages. Only a value engineering judgement for each individual case will give the correct answer. The point of this improvement idea is to reduce the retainage as much and as soon as possible.



Another recommendation deals with job personnel. One of the District Review Officers mentioned that every project engineer should be assigned an assistant. Some have them now and some do not. This assistant could work in the field office trailer and be completing a lot of the Construction Record paperwork throughout the job, such as making the necessary sketches and adding up all of the weigh tickets. This would give the project engineer more time on the job and make it an easier task to complete the Construction Record at the end of the project.

Another improvement suggestion deals with checking the Construction Record in sections throughout the job. All jobs are divided into components and a lot of the time a part is completed early in the job and no work is added to it later. In cases like this, a District Review Officer mentioned that he tells his project engineers to complete the paperwork for this part of the job and send it to the District Office whenever it is completed. This way, the whole Construction Record does not have to be checked at the end of the job. It seems as though this is a very good idea which could induce the project engineers to do a little of their work at a time instead of waiting until the end of the job to do it. Also, dealing with this is what one of the District Review Officers does in his district. If there is not much to check in the office, he will periodically go to the jobs and pick up from the project engineers items such as weigh tickets so he can get them all tabulated prior to when the Construction Record arrives. This saves him a lot of time in the long run.



A few of the District Review Officers seem to have a good idea with respect to organization throughout the checking process. They have a board in front of their desk showing the status of each contract being checked. Using this system, they can tell which contracts are running late in the 180 day payment period. This type of organization should be used throughout all six highway districts.

Added documentation is another recommendation of one of the District Review Officers. He stated that the project engineers are accustomed to calling contractors when supplemental material records are needed or when the M-39 is late being turned back signed. Because of this verbal system, some contractors claim they were never called and try to pin the time delay on the State of Indiana. Dated written letters of which copies are kept by the project engineer would help to alleviate such claims.

Finally, a few of the District Review Officers stated that their work might improve if they knew what their exact job description is. For example, they sometimes find numerical errors made by the project engineer during his calculations. The District Review Officer can either make the needed change himself or call the project engineer in to do this. In most cases, they make the change themselves. However, they are afraid of the possible consequences. One is so bold that he will fill in a supplemental material record and forge the project engineer's signature to it because this document is all that is holding up material certifications. As can be seen, some guidelines need to be set up so these men know what they can and cannot do legally.



3.6 Recommendations for Improving the Indiana State Highway Commission  
1970 Construction Record Guide for Road, Bridge, Maintenance, and  
Traffic Contracts

None of the District Review Officers voiced any major complaints about the Construction Record Guide. All felt that it served its purpose on the whole, but they did each give the researchers a few of their suggestions on how it could be improved. Most of these deal with certain forms placed in the Construction Record. However, a few deal with needed sections. Each will be discussed separately below.

- a) Repetition of sketches- Several District Review Officers said that many of the project engineers recopy their field book sketches onto IC 614 forms. This type of repetition is unnecessary. If they would take their time when drawing their original field sketches, the field book containing them could be referenced for a needed sketch. The field books become a part of the Construction Record anyway. This would cut down on the amount of paperwork in the Construction Record along with making it easier for both the project engineer and the District Review Officer.
- b) Bridge deck repair items- Two of the District Review Officers mentioned that the Construction Record Guide contains no section showing samples of how to check bridge deck repair and overlay items. These items include hand chipping and scarifying. The District Review Officers are not sure of the proper quantities for these items and feel a section is needed to cover this topic.



- c) Accuracy of calculations- It was mentioned that several of the project engineers are not following the calculation accuracies shown for the work items in the front of the Construction Record Guide. They are not following the rounding rules for the quantities. Again, an annual workshop for the project engineers should help clear up this problem.
- d) Federal funding section- One of the District Review Officers said that he would like to see a new section in the Construction Record Guide on how to handle federally funded contracts. In these contracts, there are often work items, signified as Z items, which are not federally funded while the rest of the contract is. As a note to the District Review Officers, this problem is adequately discussed in the Supplemental Instructions to Field Employees--No. 18 which was issued September 7, 1973 by W. J. Ritman, Chief of the Division of Construction of the Indiana State Highway Commission. A copy of this directive could easily be included in the Construction Record Guide.
- e) IC 612B form- Pipe and Concrete Structures- The majority of the District Review Officers feel that this form is useless. It is used to show how much of each type of pipe is laid and where. It is felt that this form repeats information shown in the project engineer's field book and is unnecessary. Therefore, the pipe information could be referenced on an IC 627 to the field book and this IC 612B form could be eliminated.



- f) Computerized dirt quantities- At present, the computer does a lot of the project engineer's dirt calculations for him. He fills out a data input sheet using numbers from his field book and the computer prints out quantities and cross sections. This printout is then included in the Construction Record. However, a District Review Officer expressed concern as to how to check these computer printouts. The only thing he can check at the present is whether the project engineer made the proper transposition of field book numbers to the computer data input sheets. There is no way of his knowing if the project engineer made an error in his field-book. Therefore, the District Review Officers need actual as-built cross sections to compare with the computer's printout.
- g) IC 611A form- Pavement- This form for pavement quantities is also felt to be unnecessary by some of the District Review Officers. This same information should be in the project engineer's field book.
- h) IC 654 form- Record of Construction (Concrete)- This form was revised in May 1972 so the old form is still in the Construction Record Guide. A few of the District Review Officers mentioned that they are not sure what goes in all of the blocks on this form. A new sample form which is explained should be placed in the Construction Record Guide. A meeting between the District Review Officers would help clear up this problem also.
- i) Date repetition- A few of the District Review Officers felt



that there was unneeded repetition of dates on forms such as the IC 608 (Title Sheet), the IC 654 (Record of Construction-Concrete), the IC 635 (Record of Completion and Acceptance), and the IC 632 (Completion Date and Liquidated Damage Data). However, these forms are all required to be in the Construction Record and some of the repeated dates are pertinent to the form. Therefore, the researchers feel that this repetition of dates is all right as long as care is taken so that the dates do not vary from form to form.

### 3.7 Summary

As can be seen, the District Review Officers provided a lot of valuable information that the researchers used in preparing this chapter. The places of disagreement between those men and the researchers were noted. It is felt that a lot of the suggestions offered by the District Review Officers would greatly increase the efficiency of the final construction contract payment procedure.



## CHAPTER 4

## RESULTS OF INTERVIEWS WITH ISHC PROJECT ENGINEERS

As was stated in Section 1.3 of this paper, interviews with several project engineers were carried out in the Crawfordsville district. The main reason for this was because of this district's proximity to Purdue University. The project engineers responded to a set of questions similar to those asked the District Review Officers. However, the primary emphasis of the questioning was placed upon the Indiana State Highway Commission 1970 Construction Record Guide for Road, Bridge, Maintenance, and Traffic Contracts. The project engineers use this manual the most of all of the Indiana State Highway Commission personnel. Therefore, their familiarity with the book made it easy for them to state their likes and dislikes about it.

The primary point that each of the interviewed project engineers made about the Construction Record Guide is that it is not too bad. It is not hard to follow and it contains the answers to most of the questions that arise during the preparation of the Construction Record. However, each did present a few suggestions on how the book could be improved. It should be noted here that a lot of their suggestions about the Construction Record Guide are the same as were given by the District Review Officers. Since these identical suggestions are explained in Chapter 3 of this paper, they will only



be listed here. However, previously unexplained suggestions will be presented in detail. Also, general suggestions about the final construction contract payment procedure as were put forth by the project engineers will be listed. The following three sections present the results of the interviews with the project engineers.

4.1 Suggestions about the Construction Record Guide Which Were Made by Both the Project Engineers and the District Review Officers

- a) Repetition of sketches is unnecessary.
- b) Bridge deck repair item needed in the the Construction Record Guide.
- c) Difficulty of filling out the IC 612B form pertaining to pipe and concrete structures.

4.2 Other Project Engineer Suggestions on Improving the Construction Record Guide

- a) Make more references to the project engineer's field book.

Many of the project engineers feel that there is a lot of recopying of field book information onto IC 615 forms which are placed in the Construction Record. These IC 615 forms are used mainly for drawings. It is felt that it would involve much less paperwork if the pertinent page in the field book was referenced instead of writing up a new form. The researchers concur in this belief.

- b) Provide all project engineers with a sheet showing the Central Office's recommendation for the order of pages in the Construction Record. This sheet should be used by all six



State of Indiana districts. The project engineers complained that the page order of the required forms changes from time to time and a general instruction sheet from the Central Office would be very helpful.

- c) Provide an example of Unclassified Excavation.

#### 4.3 Project Engineer Suggestions on the Payment Procedure Process

- a) In order to speed up the process, the project engineer could begin filling out the IC 627 forms for each work item before the actual project even begins. IC 627 forms are used for work item quantity summaries and comparisons. He could fill in the heading and the plan quantities. Then as each item is finished, he could complete the IC 627.
- b) In order to check the contractor's IT 611 form (the Material Record form), the project engineer could make up his own each month from his observations and then at the end of the month, check the form turned in by the contractor with his own. His form would give him a record of what material he knows is on the job and it would reduce the amount of checking required to determine if the contractor left something off or had an improper quantity.
- c) It would be better to be conservative and overestimate on the IC 626 forms. An IC 626 is a form entitled Change in Plans, Materials, or Quantities. The project engineer fills out this recommendation form if he encounters any work item quantity changes during the project. Being



conservative on this form would assure that if approved, the money would be available and hopefully some of it would not be used.

- d) Require all District Review Officers to be field experienced and graduate civil engineers. The reason for this deals with their checking responsibility. Right now, their main job is to sum quantities and to make sure all of the required forms have been submitted by the project engineer. They do not check the thought behind how these quantities were arrived at. If they do have a quantity question, the project engineer is able to give an explanation that the District Review Officer does not sometimes understand but assumes is feasible. Therefore, it would be better to have a person checking the Construction Record who is also capable of checking the project engineer's method of calculating quantities.

#### 4.4 Summary

As can be seen from the number of suggestions provided by the project engineers, they do not have too many complaints about the payment procedure or the Construction Record Guide. However, through interviewing the project engineers, the researchers discovered that both the Indiana State Highway Commission officials (including the District Review Officers) and the contractual data are correct about the project engineers. Most do not finish their paperwork as soon as they could. Only a few out of the several project engineers



who were talked to stated that when a work item is completed, they immediately complete the required paperwork that goes along with it. This one step would reduce the amount of paperwork time being spent at the end of the job and this would reduce interest penalties. The researchers realize that no one likes to do the paperwork but it is a necessary evil. To put it off because you could be doing something else only makes you resent it more when you have to do it later. Therefore, it is recommended that the Indiana State Highway Commission strongly emphasize to its project engineers the expediency of completing construction reports as segments of the work already completed. District Review Officers and the District Construction Engineers could also implement this philosophy into practice. Project engineers who continue to perform poorly on project reports should be relieved of their positions.



## CHAPTER 5

## RESULTS OF INTERVIEWS AT THE DIVISION OF MATERIALS AND TESTS

As was seen on the final construction contract payment procedure flowchart in Figure 1, the issuance of a Division of Materials and Tests certification is one of the primary components of the process. This division of the Indiana State Highway Commission is located in Indianapolis. In the researchers' interviews with Indiana State Highway Commission officers in the Indianapolis Central Office, with the District Review Officers, and with the project engineers, this division was constantly mentioned as one of the main reasons that interest penalties were occurring. The Penalty History Analysis section (7.7) of the Data Analysis chapter presents data that substantiates this opinion. Therefore, the reasearchers traveled to the Division of Materials and Tests assuming it contributed to one of the final construction contract payment procedure's main problems and hoped that by talking to the personnel there that they could discover the basis for the problems. They also hoped to come up with recommendations that might improve this division. The researchers found something quite the contrary when they interviewed three of the men there. There has been a change in procedure at the Division of Materials and Tests which began approximately in March of 1977. It looks as though the efficiency of the division will be greatly increased by this new procedure and, hopefully, reductions in



future contract penalty data will bear this out. Some of their old policies did contribute to their division being a major cause of interest penalties, but most of those policies have been changed. Therefore, this chapter will present information in the following sections:

- 5.1 The Functions of the Division of Materials and Tests
- 5.2 The Organizational Structure of the Division of Materials and Tests
- 5.3 The Flow of Paperwork Through the Division of Materials and Tests
- 5.4 Management Checks to Increase the Division's Efficiency
- 5.5 Possible Reasons for Late Issuance of a Division of Materials and Tests Certification That Are Not the Fault of the Division
- 5.6 Recommendations
- 5.7 Summary

#### 5.1 The Functions of the Division of Materials and Tests

The primary objective of the Division of Materials and Tests is to certify that all materials used on a construction project meet State of Indiana specifications. It accomplishes this either by testing a sample of each material in its laboratories or by checking a manufacturer's certification test. The Division of Materials and Tests also checks to make sure that for each quantity of material used on a project, the right frequency of sample spot checks have been made. For example, a slump test is required for all concrete



paving operations. The Manual for Frequency of Sampling and Testing and Basis for Use of Materials states that one slump test is required for every 2000 linear feet of pavement but no fewer than one slump test should be taken each day. Therefore, if 4000 linear feet of concrete pavement are laid in one day, the Division of Materials and Tests makes sure two slump test reports are sent to them for checking. The third category the Division of Materials and Tests checks is the basis for use of materials used on a contract. When a project engineer fills in the Basis for Use column on the Material Record form (IT 611), he is showing his criteria for accepting the material for his construction project. He can justify material acceptance either by a Division of Materials and Tests sample test, a manufacturer's certification, or by visual approval. However, certain materials require a certain test to show up on the Basis for Use column to assure the material is all right to use on the job. For example, there are three types of material certifications that can be received from a manufacturer-- namely A, B, and C. Type A is the highest level of certification in that it contains with it a certified copy of a laboratory report showing actual test results which meet State of Indiana specifications on the material tested. The type C certification is the lowest level since it certifies only that the material supplied by the manufacturer complies with the State of Indiana specifications. Therefore, if a material calls for a type C certification in the Basis for Use column, a type A, type B, or type C certification will suffice. However, if a type A certification is called for and a type C is received from the manufacturer, the project



engineer cannot accept the material. Using the Manual for Frequency of Sampling and Testing and Basis for Use of Materials, the Division of Materials and Tests makes sure that the project engineer has made no mistakes in approving materials without the proper testing certification. The fourth and final set of information that the Division of Materials and Tests checks for on each contract is final payment quantities. Every month, it receives Material Record forms (IT 611) that show the quantity of each material used by the contractor during the month. At the end of the project, these monthly totals for each work item are summed to arrive at job quantities. The Division of Materials and Tests also receives at the end of the job IC 642 forms. These forms, entitled Comparison of Estimates--Original and Final, show the final quantity of each work item for which the State of Indiana expects to pay the contractor. The Division of Materials and Tests makes sure that its quantity totals derived from the IT 611's are equal to or greater than the payment quantities shown on the IC 642. If the totals on the IT 611's are smaller, this could mean that without this checking procedure, the State of Indiana could end up paying for more material than was used on a job. If the totals are larger, the State is getting more material than it is paying for.

## 5.2 The Organizational Structure of the Division of Materials and Tests

The Division of Materials and Tests is composed of four divisions. Each is responsible for checking different work item quantities on both the IT 611's and the IC 642's. The first division is called Field Control. It is responsible for checking quantities on work items such as pipe and its accessories, aggregates, and bituminous



materials. The second division is the Soil Department. It checks soil quantities such as those for B-Borrow, compacted base material, and common excavation. The third section is entitled Research and Development and the primary category of work items that it checks is concrete. The fourth division is called the General Office. It checks items such as dry cement, asphalt, reinforcing steel, and metal products such as signs or guardrails. Due to the fact that each division checks different work item quantities, all of the paperwork has to flow through all four divisions; how this is accomplished is explained in the next section.

### 5.3 The Flow of Paperwork Through the Division of Materials and Tests

How the paperwork flows through the Division of Materials and Tests is very important to its efficiency. Each step in the process will be discussed in detail and improvements to the procedure which were made in March 1977 will be pointed out. The steps are as follows:

a) RECEIPT AND CHECKING OF THE MATERIAL RECORD FORMS (IT 611)-

Each month in which a project is in progress, the Division of Materials and Tests receives an IT 611 for every project that is in progress in each district. This form is sent from the District Office. It is logged in on a sheet showing the date it was received. The IT 611 then has a distribution stamp place on it by the Assistant to the Office Engineer for routing through all four sections of the Division of Materials and Tests. He then starts the form's distribution to a division such as Field Control. The IT 611 is hand carried to Field Control which checks to make sure the



correct number of sample tests have been completed for each work item shown on the IT 611 along with checking that the Basis for Use column and the Source of Supply column for each work item are correct. After sending the IT 611 to one of the four divisions, the Assistant to the Office Engineer expects the checked IT 611 to be back on his desk within a week in order to distribute it to the next division. If it is not, he goes to that division and picks it up himself after making sure it was checked. Prior to March 1977, after sending the IT 611 to a division, there was no requirement that it be back to the central distribution point within a week. It would sometimes sit on a man's desk for weeks or even months if the man happened to be sick, on vacation, or just busy. This change in procedure alone should greatly increase the efficiency of the Division of Materials and Tests and decrease the number of times it is a cause for an interest penalty. As was stated previously, this checking process is repeated monthly for each new set of IT 611's that arrives at the Division of Materials and Tests from the districts. The division strives to complete this checking process prior to the arrival of the new crop of IT 611's. This prevents a backlog of work along with utilizing the common sense policy of doing your work a little at a time instead of waiting until the end of the job to begin it.



b) RECEIPT AND CHECKING OF THE PRELIMINARY COMPARISON OF ESTIMATES-

ORIGINAL AND FINAL FORM (IC 642)- After the project has been completed and the project engineer has turned in the Construction Record to the District Office, they transfer his work item total quantities onto an IC 642 which is sent to the Division of Materials and Tests. This form is then logged in by the Assistant to the Office Engineer who also places the distribution stamp on it. It is then sent to each division in the same manner as the IT 611's were. If the IC 642 is not back within a week, he goes looking for it and finds out why there is a hold-up in the process. Each division totals up the IT 611 quantities it has checked for the project and makes sure this sum is equal to or greater than the sum shown on the IC 642. If the sum of a work item is smaller, a discrepancy letter is issued to the district explaining the problem and asking for its assistance in solving it. Many times, an IT 611 is not sent to the Division of Materials and Tests and this makes the IT 611 total quantity less than the IC 642 quantity. Also, a contractor frequently leaves off an item on the IT 611 which is missed by the project engineer who checks this form. This makes the IT 611 total work item quantity too low. A supplemental IT 611 is needed in this case to make sure the IT 611 total quantity is equal to or greater than the IC 642 quantity. When answers are received to the discrepancy letter, the quantities can then be okayed. If an answer is not received



within two weeks, a call is made to find out why.

- c) RECEIPT AND CHECKING OF THE FINAL COMPARISON OF ESTIMATES-ORIGINAL AND FINAL FORM (IC 642)- After the District Office has checked the Construction Record for final work item quantities, it issues a final IC 642 to the Division of Materials and Tests. This form usually shows the same work item quantities that were seen on the preliminary IC 642. Because of this, the Assistant to the Office Engineer checks this form against the IT 611 total quantities. However, if a work item on the final IC 642 shows a big change in quantity from the preliminary IC 642, he sends the final IC 642 to the appropriate division in the Division of Materials and Tests for checking.
- d) RECEIPT OF THE DISTRICT OFFICE MATERIALS' LABORATORY CERTIFICATION- The District Office is also required to submit a material certification on items that it tests. The District Office Materials' Laboratory checks items such as aggregate gradation and air content of concrete but it does not have the capability of checking things such as the tensile strength of reinforcing steel, paint mixtures, epoxy characteristics, or the compressive strength of concrete. Therefore, the Division of Materials and Tests must wait and make sure the District Office Materials' Laboratory issues its certification. After this has been done and a copy has been sent to the Division of Materials and Tests, it can then issue the Division of Materials and Tests certification.



e) ISSUANCE OF THE DIVISION OF MATERIALS AND TESTS CERTIFICATION-

Many facts have to be assured before the issuance of the certification. They are as follows:

- 1) All of the discrepancy letters to the districts have had to have been answered satisfactorily. The needed IT 611's or supplementary IT 611's must have been received and checked in the Division of Materials and Tests.
- 2) A copy of the District Office Materials' Laboratory certification must be on file in the Division of Materials and Tests.
- 3) Throughout the project, the Division of Materials and Tests is testing samples of materials used on the job. If any of the samples fail to meet the specifications, a pink sheet is issued to the project engineer notifying him of this fact. The failures are also discussed once a month by the Failure Committee in the Central Office in Indianapolis. They determine if the material can be used or if new material is required. If the failed material is approved by the Failure Committee, the Division of Materials and Tests then writes exception letters to the districts and project engineers about these failures. All of the failed material pink sheets have to be cleared up prior to the issuance of the Division of Materials and Tests certification.



4) If a project engineer has put down the wrong basis for use for a work item on the IT 611, a blue letter is issued notifying him of this fact. All correct basis for use certifications are required prior to certification issuance.

After all of the four facts as discussed above have been assured along with those pertaining to the IT 611's and the IC 642's, the Division of Materials and Tests issues its certification.

#### 5.4 Management Checks to Increase the Division's Efficiency

In order to increase its efficiency and to assure that it causes a low percentage of the interest penalties, the Division of Materials and Tests utilizes a few checking systems which are the responsibility of the Assistant to the Office Engineer. The first of these is the IT 611 summary sheet. The Division of Materials and Tests knows all of the contracts that are in progress by its receipt of an IT 611 each month from all contracts. It keeps track of all IT 611's that are received and it compiles a list of all IT 611's that were not received during the month for contracts still in progress. The Division of Materials and Tests knows a contract is still in progress if it has not yet received an IC 642 from the District Office. This list is then sent to each district every month. The district is required to respond about all IT 611's pertaining to it that have not been received by the Division of Materials and Tests. This checking system finds mistakes sooner and should decrease interest penalties. The second checking system pertains to the IC 727 form



issued by the Indiana State Highway Commission each month. This form, entitled the Road and Bridge Construction Record Status Report, lists all contracts which have been completed but for which final payments have not been made. It lists reasons why the final construction contract payment procedure is still in progress. Many of the reason entries state that the contract is awaiting Division of Materials and Tests certification. The Assistant to the Office Engineer goes over every contract on this form each month and checks to see what his division's status is in the flow of its checking procedure. He makes sure all of his contract IT 611 and IC 642 checking is up to date along with determining if the hold-up is due not to his office but to the District Office or the project engineer. This checking system makes the Division of Materials and Tests aware of the status of all contracts and should lead to fewer interest penalty causing errors. The third and final checking system deals with the distribution stamp already mentioned. For every contract that the Division of Materials and Tests is working on, a form is stamped showing the four different divisions and the dates the IT 611's and the IC 642's were sent to and received from the divisions. If blanks show up on the date blocks, it means that the forms are still in a certain division or haven't been sent there yet. This checking procedure assures complete distribution along with making the Assistant to the Office Engineer aware of any long delays in a certain section. All three of the mentioned checking systems appear very adequate and can do nothing but to improve the final construction contract payment procedure.



## 5.5 Possible Reasons for Late Issuance of a Division of Materials and Tests Certification That Are Not the Fault of the Division

In defense of the Division of Materials and Tests, it appears that this group is blamed for a lot of delays in the final construction contract payment procedure which are the fault of other groups of people. When the IC 727 states that the contract is awaiting the Division of Materials and Tests certification, several factors could be the cause of this but which are not the fault of this division. Each factor to be mentioned has been discussed in this chapter but not in this context. They are as follows:

- a) Discrepancy letters- If a work item quantity is found to be incorrect, it is the fault of the contractor or project engineer, not the Division of Materials and Tests unless this division lost a form. All of these discrepancy letters have to be cleared up prior to certification issuance.
- b) Failed tests- If a material sample fails a test and the Failure Committee has not yet discussed the matter, the delay is not the fault of the Division of Materials and Tests.
- c) Basis for Use Certifications- If the project engineer puts down an incorrect basis for use and a delay results, it is his fault, not the Division of Materials and Tests.
- d) District Office Materials' Laboratory certification- Even if the Division of Materials and Tests has all of its work done, it can not issue a certification until it receives the same from the District Office Materials' Laboratory. This again is not the fault of the Division of Materials and Tests.



All four of the factors discussed above help to decrease the percentage of contracts in which interest penalties were caused by the Division of Materials and Tests. This fact is reiterated in the Penalty History Analysis section (7.7) of the Data Analysis chapter. However, it should be remembered that prior to March 1977, the division's operations were much more inefficient than they are now. The division did cause a large share of the interest penalties but its improvements should decrease this percentage. Recommendations on how the Division of Materials and Tests could be further improved will be discussed in the next section.

#### 5.6 Recommendations

Even though the efficiency of the Division of Materials and Tests was increased with the changes made in March 1977, there is still room for improvement. The following recommendations are offered for future consideration and possible implementation:

- a) Stop both distribution cycles- At present, the IT 611's are sent through the four stop cycle each month along with the preliminary IC 642 at the end of the job. The thousands of forms that travel through these cycles each year present many chances for lost or misplaced forms. Also, the work required to keep track of where the forms are and should be in the cycle is immeasurable. Therefore, it is recommended to keep all of the forms at one desk, namely that of the Assistant to the Office Engineer. He then would not have to keep track of where all the forms are since he would have them.



If he was given an assistant to help him, he could perform all of the work the four sections do now. This could save the State of Indiana money in salaries since it would be deleting unnecessary personnel.

- b) Issue the Division of Materials and Tests certification without having the District Office Materials' Laboratory certification- The researchers feel that the hold-up that occurs when there is a wait on this District Office certification is unnecessary. Even more unnecessary is the need for two separate material certifications. It seems as though every sample of every work item could be checked in the Division of Materials and Tests. Even if this drastic step is not taken, the need to wait on the District Office Materials' Laboratory certification is unjustified since when the Division of Materials and Tests issues its certification, it is certifying every piece of material on the job.
- c) Check all Manufacturer's certifications- At present, the number of manufacturing firms' certifications which are checked for accuracy is very low due to not having enough personnel. The State of Indiana is assuming that the test results from the manufacturers are valid in almost all cases. Tests by the Division of Materials and Tests have shown that mistakes are made by the manufacturers and results which they say meet the specifications really do not. Therefore, all manufacturer certifications should be checked by the Division of Materials and Tests' personnel, even if



more personnel are needed by this division.

- d) Computerize the paperwork procedure through the Division of Materials and Tests- Almost the entire checking procedure could be easily computerized. The computer could total up IT 611 work item quantities and make sure the quantities are equal to or greater than the IC 642 quantities. The computer could determine if the required number of sample tests were taken according to the work item quantities. Finally, the computer could check to see if the Basis for Use certifications are as required. For each of these three computerized activities, the computer would print out an error message when there is noncompliance to Indiana State Highway Commission specifications. At present, the computer prints out for project engineers test results of samples that have been sent in to the Division of Materials and Tests. The researchers feel the added computerization could greatly aid the paperwork aspect of this division.

Each of the above suggestions should help the final construction contract payment procedure in that each will increase its efficiency.

### 5.7 Summary

This chapter has shown the results of the researchers' discussions with Division of Materials and Tests personnel along with stating a few of their own opinions. The present procedure, greatly improved over the past, was laid out. Finally, it is felt that implementation of one or all of the recommendations could greatly expedite the payment process.



## CHAPTER 6

RESULTS OF THE REVIEW OF THE INDIANA STATE HIGHWAY COMMISSION 1970 CONSTRUCTION RECORD GUIDE FOR ROAD, BRIDGE, MAINTENANCE, AND TRAFFIC CONTRACTS

One of the primary objectives of this research study was to thoroughly review the Indiana State Highway Commission 1970 Construction Record Guide for Road, Bridge, Maintenance, and Traffic Contracts. It was prepared in 1970 and has not been updated since that time. The guide is used by the project engineer as a reference of how to complete the work item quantities for the contract he is supervising. During the Joint Highway Research Advisory Board meeting on December 1, 1976 in which the proposal for this research study was approved, it was stated by one of the Indiana State Highway Commission officials that it might be good for a layman like the researcher to study this book and propose improvements. Since the researcher has never been a project engineer for the State of Indiana and therefore has never prepared a final Construction Record utilizing this book, he felt that the best way for him to review it was to go through the guide page by page and see if he could follow the work item examples. The results of this review are interesting and appear in the following few paragraphs.

The first thing noticed by the researcher about the guide during its review was the number of mistakes it contains. These errors include numerical calculation errors, misspellings, and incorrect



transpositions of data from page to page. A listing of all of these mistakes can be found in Appendix C. These errata sheets should be issued to all project engineers so they can correct their Construction Record Guides. The project engineer completing the final construction contract payment procedure for the first time relies heavily upon this book. In order to compute some of his work item quantities, he has to follow the examples in the guide step by step. Examples with mathematical mistakes in them make it harder on the neophyte. He gets confused when his calculations which are correct give him one answer while the guide's calculations, which he assumes to be correct but are not, give him another. Therefore, a careful check of the next edition of the guide could prevent a lot of headaches.

The layout of the Construction Record Guide seems adequate. It is divided into several major topics such as Grading Items, Bridge Items, and Traffic Items. This type of organization provides for easy referencing by the project engineer.

The researcher's review of the guide resulted in no new recommendations for its improvement beyond those found in the interview chapters of this paper with both the project engineers and the District Review Officers (chapters 3 and 4). Each of those two chapters listed several improvements to the guide which will not be repeated here. However, it should be stated that the researchers feel that the Indiana State Highway Commission 1970 Construction Record Guide for Road, Bridge, Maintenance, and Traffic Contracts is on the whole adequate and provides a good reference for both new and experienced project engineers. The guide does not inhibit the efficiency of



the final construction contract payment procedure process. As the Data Analysis chapter will show, the person using the Construction Record Guide is the primary reason for the problems with the payment process. The guide lays down the proper ways of computing the work item quantities, but getting the project engineers to compute them on time and correctly is another matter.



## CHAPTER 7

## DATA ANALYSIS

As was mentioned in the Objectives of the Study section (1.2), the data analysis of the final construction contract payment procedure encompasses all highway related construction contract data for Indiana since 1972. The reason for this is twofold. First, the 180 day payment statute was passed in 1972, so there would not be any contract penalties prior to that year. Secondly, the State of Indiana began compiling contract data using a computer in 1972. Therefore, it was much easier for the researchers to scan the computer printouts for data rather than to dig through the Indiana State Highway Commission's archives to find pertinent highway related construction contract data. A sample of the contract data issued by the State of Indiana is shown in the Computer Program Development section (7.1).

The data analysis covers a wide range of topics. All pertain to contract penalties but some look at the interest penalties from different viewpoints. The following are the sections of this Data Analysis chapter:

- 7.1 Computer Program Development
- 7.2 Penalty Breakdown by Year
- 7.3 Penalty Breakdown by Contract Type
- 7.4 Penalty Breakdown by Contract Duration



#### 7.5 Penalty Breakdown by Geographic District

#### 7.6 Penalty Breakdown by Project Engineer Type

#### 7.7 Penalty History Analysis

#### 7.8 Liquidated Damages Analysis

Each section will contain an analysis of the trends shown by the contract data along with pertinent tables or graphs of data. Whenever penalty totals in terms of dollars (\$) are expressed on the graphs, these sums will have a number in parentheses above them. This number signifies the number of contracts in which penalties were paid which make up that total amount. This allows for the computation of average penalties if it is so desired.

As will be noticed when the data is presented in tabular or graphic form, no penalties were paid during 1972 and 1973 and very few were paid in 1974. The reason for this fact has already been mentioned in the Justification for the Study section (1.1). When the Indiana General Assembly changed the contract payment statute in 1972 pertaining to the State of Indiana having 180 days to pay the contractor, they also decided that this new law could only be applied on highway related contracts for which bids on these contracts were received from possible contractors on or after March 1, 1972. In reviewing the Indiana State Highway Commission's computer print-outs of contract data, the majority of the contracts in which final payments were made in 1972, 1973, and 1974 were let prior to this date. Therefore, it is impossible for these contracts to be assessed an interest penalty, even if they were paid late by the State of Indiana. The tables and graphs might be misleading to some people.



However, it should be kept in mind that if the new statute had been made retroactive to for example 1970, the penalty totals for 1972, 1973, and 1974 would have shown a large increase over what they show now.

Finally, it should be remembered that the 1977 data points as expressed on the tables and graphs are projections. The actual data compilation ended with the August 31, 1977 computer printout from the Indiana State Highway Commission. This is because it was anticipated that this investigation would be completed by late November 1977. Since time was needed to analyze the data, it was felt by the researchers that cutting the data off three months prior to completion of the study would be feasible. Therefore, the 1977 projections are based on the trends shown by the data during the first eight months of 1977. The eight month dollar totals were multiplied by 1.5 to get the twelve month projections; percentages were not adjusted.

Following this introduction to the Data Analysis chapter are the eight sections which were listed earlier. The researchers know that the data could have been analyzed in other ways and that other variables could have been included during the data analysis besides contract type, project engineer type, year of payment, and geographical district. However, it was felt by the researchers that these four are representative of all others and that an analysis using them would arrive at similar conclusions in comparison to one in which other variables were considered.



### 7.1 Computer Program Development

The compilation of past and present highway contract data was made much easier through the usage of a computer program. When it was decided that a data analysis was necessary for the contract payment procedure, the fact that the contracts can be broken down in several ways quickly surfaced. These divisions of each contract are as follows:

- a) Penalty- yes or no.
- b) Contract type- Road, Bridge, Road-Traffic, Road-Surfacing, or Road-Maintenance.
- c) Year the contract payment procedure was completed- 1972, 1973, 1974, 1975, 1976, or 1977.
- d) Geographic district- Crawfordsville, Fort Wayne, Greenfield, LaPorte, Seymour, or Vincennes.
- e) Project engineer type- city, county, or state.

If one takes the product of the number of subdivisions in each division, it can be seen that there are 1080 possible types of contracts. Therefore, it was quickly decided that the time it would take to write a computer program for this data would be very beneficial to the researchers.

With respect to contract data, the researchers were constrained by the fact that the Indianapolis Central Office has been compiling contract data only since 1972. This office releases a computer printout each month showing both the highway contracts which are in progress and those that have been completed during the year. It is from these printouts that the researcher derived the required



information in order to make a data analysis. A sample of the data received from Indianapolis can be seen on the next page in Figure 2. By referring to the headings at the top of the sample, one can easily ascertain what each section of the contract data sample refers to. From this data, the researchers extracted five contract breakdown divisions that they required for the computer program.

This data was then placed on computer cards in the following format:

Columns 1-8:	Contract number
Columns 10-11:	Contract type
Column 13:	Project engineer type
Column 15:	Penalty- yes or no
Columns 17-24:	Penalty amount
Column 26:	Geographic district
Columns 28-29:	Reason for penalty
Column 31:	Year the contract payment procedure was completed

A coding system was devised for several of these data components in order to facilitate both programming and data handling. For the type of contract, the coding is as follows:

<u>Contract Type</u>	<u>Code</u>
Road	1
Bridge	2
Road-Traffic	3
Road— Surfacing	4
Road-Maintenance	5



FOR PERIOD ENDING OCT 1, 1977

INDIANA STATE HIGHWAY COMMISSION  
CONSTRUCTION REPORT

CONTRACT	MILE CONTRACTOR	BLW PRICE	LETTING COMP. DATE	% PERCENT COMPLETED	LINE B/L
PROJECT	TYPE	COOL	FIRST WORK LAST WORK	A = PERCENT COMPLETED	ND. PKA
STRUCTURE	LOCATION	FINAL PRICE	SIGNED	/	QU
ROAD	INTEREST	180 DAY	REC'D C.C.	+ = PERCENT AHEAD OR BEHIND	RET
LENGTH	LIG. DAMAGES	NOTICE	FINAL EST.	* MAY JUN JUL AUG SEP OCT	LCK
R -09908 ST-69' W J5 41 7.961 Mi.	07961 MCMAHAN & CONNOR CONSTRUCTION TYPE PLAIN CONC. PAVE US 41 FROM NORTH EDGE OF EDSWELL TIC JUST SOUTH OF US 52. BENTON CO.	\$ 3,437,373.51(A10-22-74)A 2,434,725.07(B10-29-74)(B)08-09-76 1,674.40 (C11-04-74)(C)08-21-77*	08-09-76 02-05-77 07-13-76	COMPLETE & ACCEPTED COMPLETE & ACCEPTED FINAL ESTIMATE PAID	US CO- 15 4; 15 4; 25 100
PES/S = KENNETH BROOKS PHONE = 317-384-1706			100-ST		35
d -09936 ST--307181 c3-bc-2036 SK 63 J. Joez 2 Mi.	00062 WEDELL BROTHERS CONSTRUCTION TYPE STEEL BEAM SH 63 OVER PENN CENTRAL, 0.7 MI. N. OF US 136a. PES/S = HAROLD CLOSSIN PHONE =	\$ 440,668.25(A104-22-75)A 432,564.30(B105-19-75)(B)09-20-76* (C106-02-75)(C102-10-77)*	150 40 08-04-76 03-19-77 02-01-77	COMPLETE & ACCEPTED COMPLETE & ACCEPTED FINAL ESTIMATE PAID	05 C66 10 S4 15 02 20 U.J
R -09749 ST--307181 SR 63 7.962 Mi. 7.962 Mi.	07962 RALPH FUGERS CO. TYPE PRE-GRADING SR 63 FROM 0.5 MI. N. OF US 136 TIC 1.5 MI. S. OF SR 28. 7.962 Mi. PES/S = MICHAEL WINK PHONE = 317-793-4722	\$ 5,921,008.42(A112-17-74)A 5,957,517.50(B112-23-74)(B)08-31-76* 4,044,68 (C101-14-75)(C)09-01-77*	150 40 08-29-76 05-28-77 08-23-77	COMPLETE & ACCEPTED COMPLETE & ACCEPTED FINAL ESTIMATE PAID	05 C66 10 S4 15 63 20 U.O 25 103
3 -09960 1-RF-1-65-5(47)139 1-65-139-2140JB 0.000 Mi.	00000 E. H. HUGHES CO. TYPE BRIDGE PAINTING PAINTING VARIOUS STRUCTURES CN US 41, US 52, 1-65, SR 39, 6, SR 42. VARIOUS COS. PES/S = JOHN STIMAC PHONE =	\$ 308,970.00(A107-22-75)A 296,396.58(B108-15-75)(B)08-10-76* 4,000,00(C108-25-75)(C)05-18-77*	111-29-75* 07-21-76* 02-06-77 04-14-77* 05-18-77*	COMPLETE & ACCEPTED COMPLETE & ACCEPTED FINAL ESTIMATE PAID	05 MO 10 1- 15 65 20 0.0 25 103
R M-09975 VARIOUS ROADS 0.133 Mi.	00000 STEEL ERECTION CO. TYPE BRIDGE PAINTING PAINTING VARIOUS STRUCTURES CN US 41, US 52, 1-65, SR 39, 6, SR 42. VARIOUS COS. PES/S = ROBERT HUTCHINSON PHONE =	\$ 39,450,00(A101-21-75)A 40,230,00(B109-09-75)(B)09-29-76* 420,00(C109-10-75)(C)108-02-77*	90 40 07-21-76* 03-28-77 04-21-77* 05-18-77*	COMPLETE & ACCEPTED COMPLETE & ACCEPTED FINAL ESTIMATE PAID	05 MO 10 1- 15 VAR 20 0.0 25 103
3 -10073 RS-235(3)	00133 MICHAEL CONSTRUCTION CO. TYPE K.C. SLAB CO. RD. OVER BROWNS MCNULTY CREEK IN MECHANICSBURG. 0.133 Mi.	\$ 170,151.00(A104-22-75)A 150,397.98(B106-06-75)(B)11-01-75*	75 40 10-06-75* 05-03-76 (C106-23-75)(C)04-11-77*	COMPLETE & ACCEPTED COMPLETE & ACCEPTED FINAL ESTIMATE PAID	05 C66 10 10 15 0.0 20 U.J 25 100

65

SAUNDIE COMPANY DATA FROM THE INDIANA STATE HIGHWAY COMMISSION  
Page 2



The project engineers were coded as shown below:

<u>Project Engineer Type</u>	<u>Code</u>
City	1
County	2
State	3

The fact that there was a penalty on a contract is connoted by the number 1. The number 2 signified that there was no penalty.

The geographic districts were coded in the following manner:

<u>Geographic District</u>	<u>Code</u>
Crawfordsville	1
Fort Wayne	2
Greenfield	3
LaPorte	4
Seymour	5
Vincennes	6

The major reasons for penalties are coded as follows:

<u>Reason</u>	<u>Code</u>
No penalty	0
Project engineer turned in the Construction Record late	1
Late issuance of the Division of Materials and Tests certification	2
Project engineer turned in the Construction Record incomplete or with revisions required	3
Need the M-39 from the contractor	4
Need an approved IC 626 from the Central Office or the contractor	5



<u>Reason</u>	<u>Code</u>
Lengthy check in the district office	6
Late issuance of the District Office Materials' Laboratory certification	7
Late issuance of the supplemental IT 611's	8
Late receiptal of a sign certification letter	9
Lengthy processing by IBM	10
Delay at the Central Office	11
Late issuance of a core report	12
Contractor protesting work day charges or approval of extension time	13
Holding for laboratory numbers	14
Awaiting FHWA approval for a time extension	15
Awaiting IC 115 (Extra Work Agreement)	16
Miscellaneous or other	17

The year the contract payment procedure was completed was coded according to the last digit in the year. For example, the code for a contract completed and paid in 1976 is 6. It should be noted that this coding system would have to be altered slightly if the computer analysis was carried out in the 1980's due to the repetition of unit digits for each decade. The program is set up so that the year code can easily be changed into a two digit number by altering one format statement.



The actual computer program was written by the researchers in the Fortran language. It makes use of several "IF Statements" which facilitate the required branching that is needed to differentiate between the 1080 possible types of contracts. The general layout of the computer program can be seen in Figure 3 on the next page which is the Computer Program Flowchart. A copy of the actual computer program is illustrated in Appendix A.

Output for the computer program consists of a number of tables. The first table lists the contracts for the year in which a penalty occurred along with the actual penalty amount. At the bottom of this table is the total penalty amount paid by the State for the year. This first table is followed by five sets of tables, each of which contains data for a certain contract type. Each of these five sets of tables contains the following information for the year:

- a) The percentage of contracts of a certain type in which a penalty was paid.
- b) A breakdown by districts of the percentage of penalties paid for a certain contract type.
- c) A breakdown by districts with respect to penalty percentages versus project engineer type for a certain type of contract.
- d) The total penalty paid for a certain contract type.
- e) A breakdown by districts of penalty amounts versus project engineer type for a certain type of contract.
- f) A breakdown by project engineer type of the total penalty amounts paid for a certain type of contract.



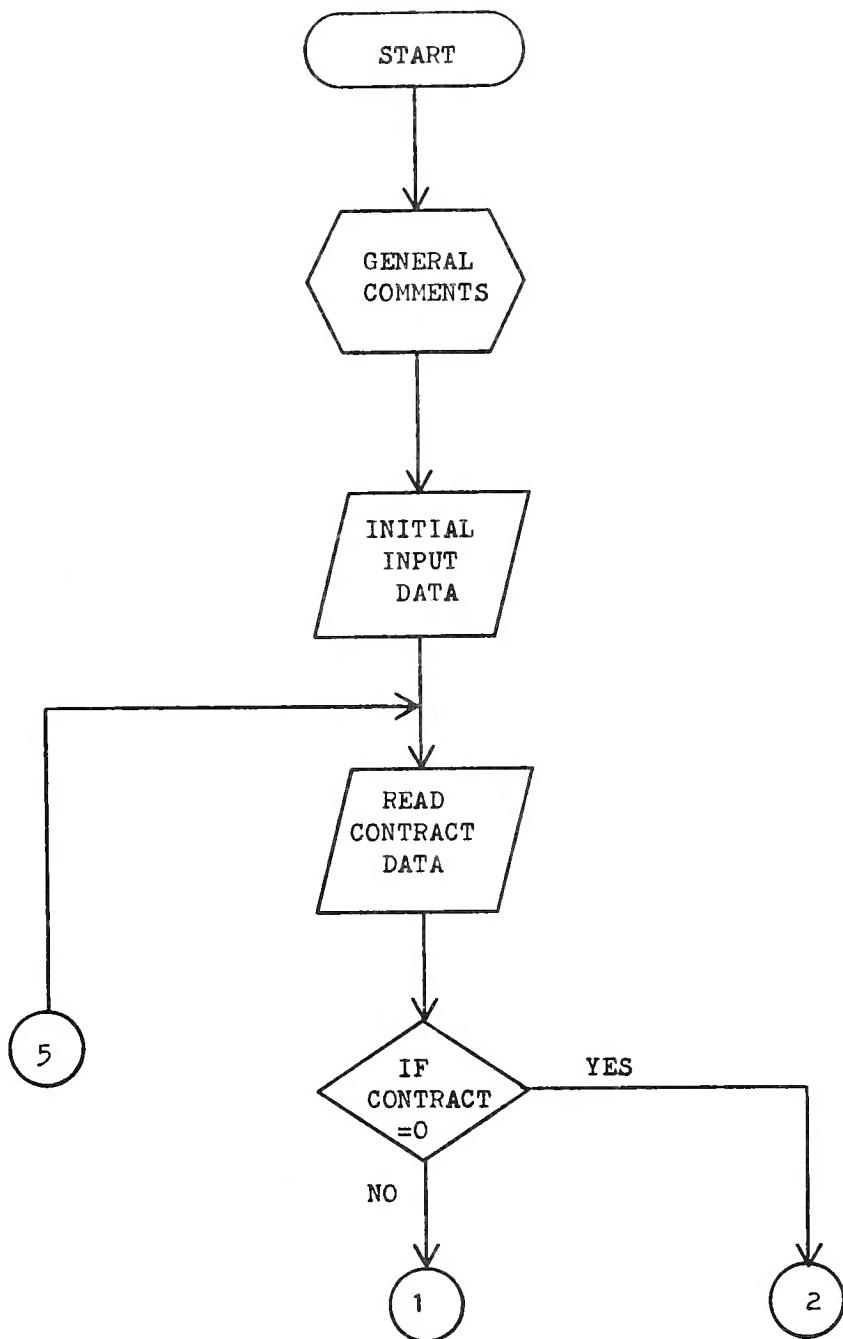


Figure 3

COMPUTER PROGRAM FLOWCHART



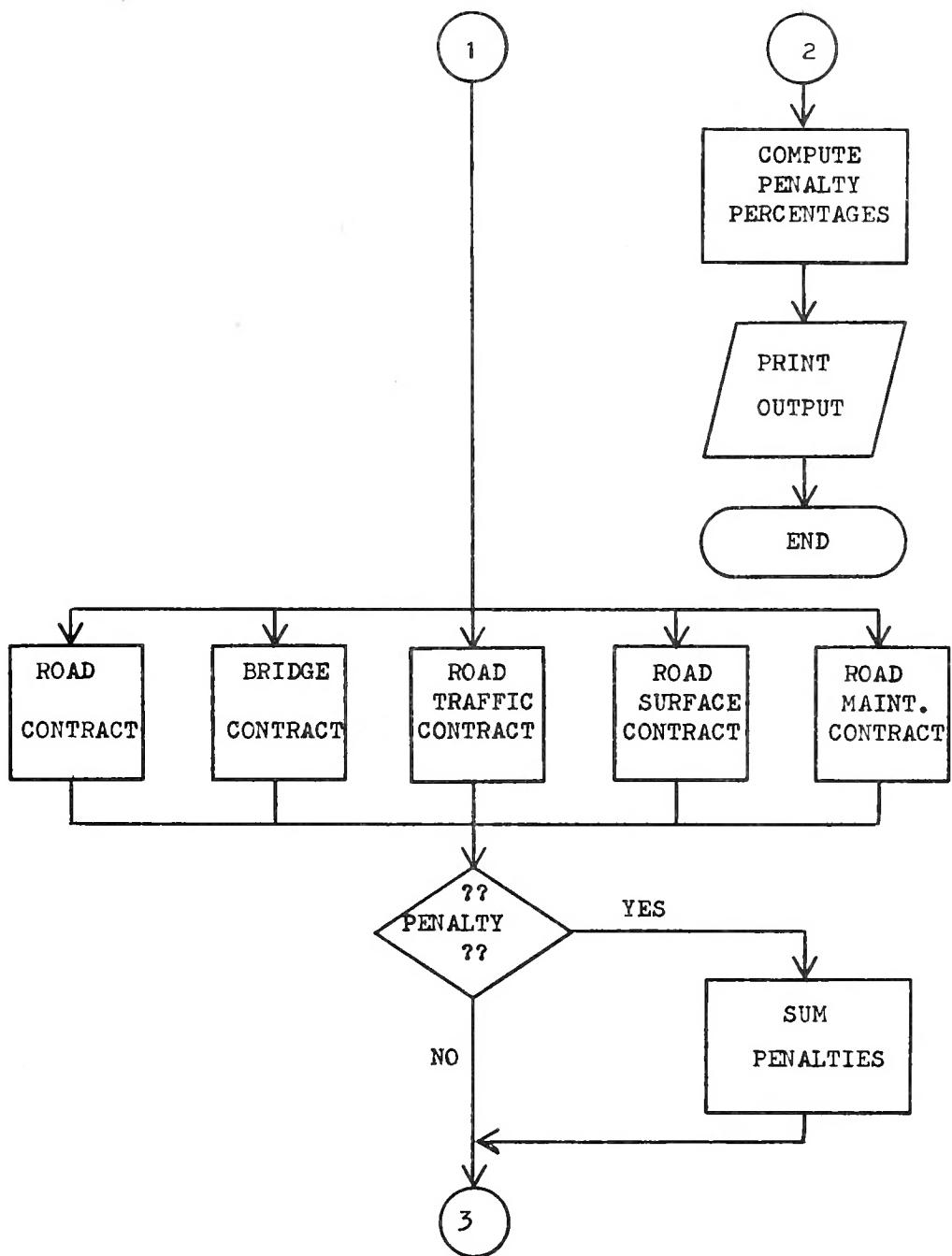


Figure 3, cont.



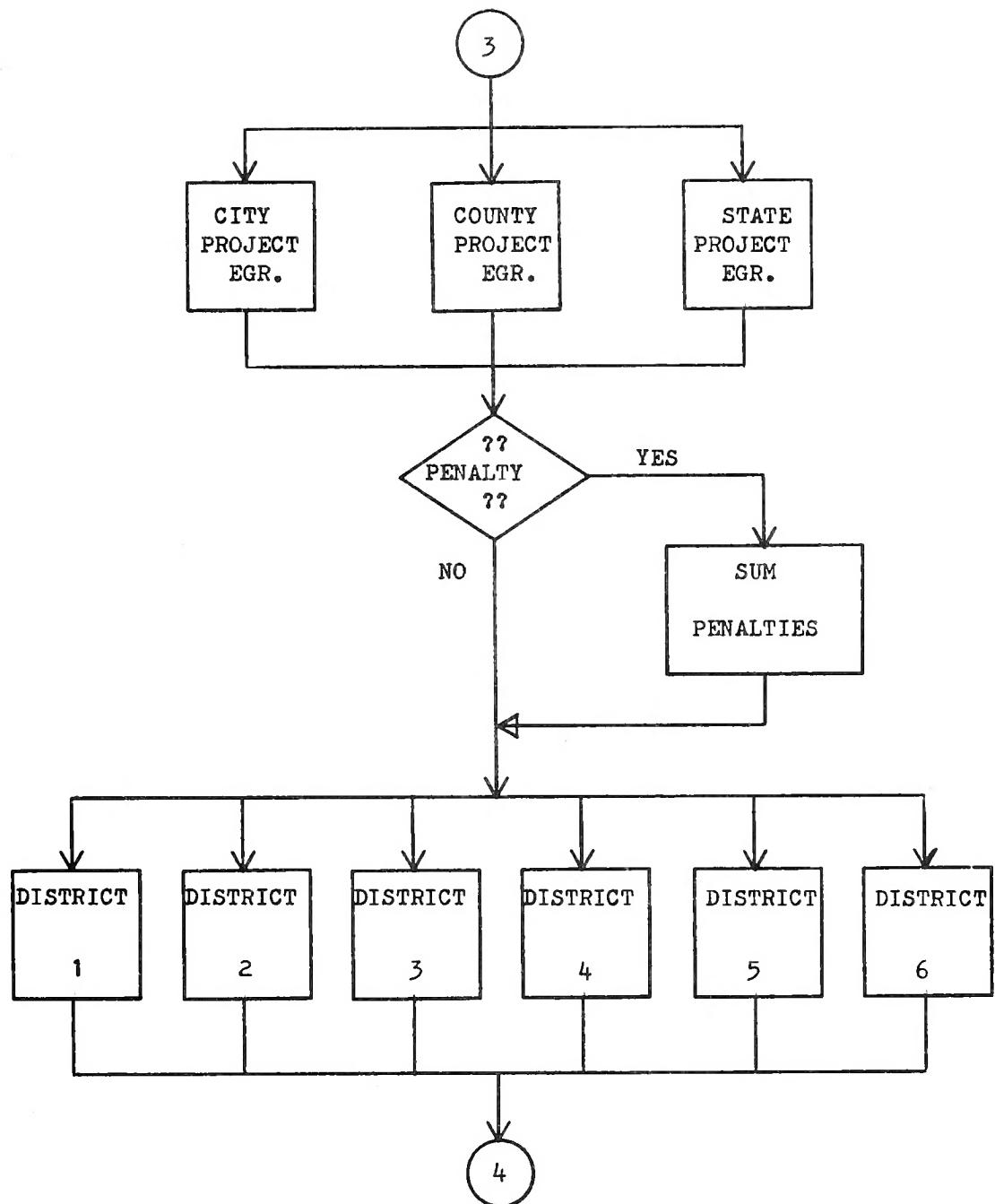


Figure 3, cont.



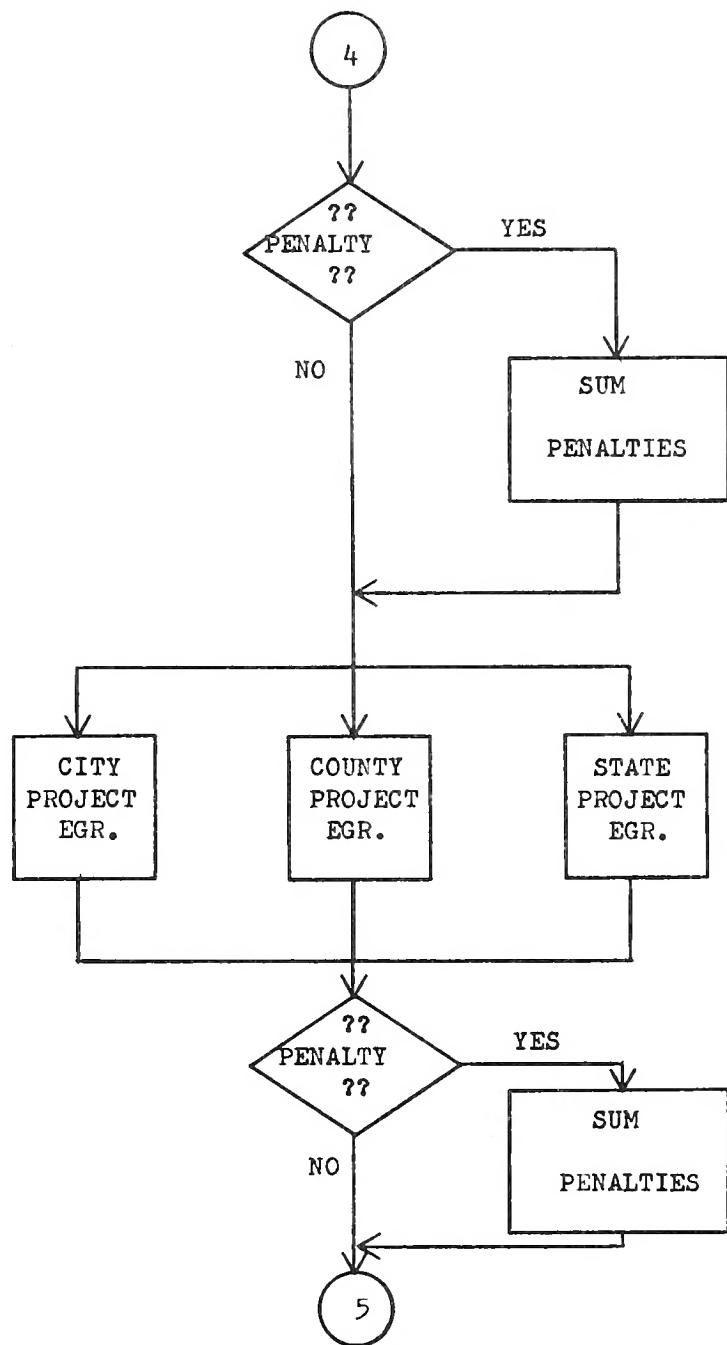


Figure 3, cont.



An example of the output is shown in Appendix B. This output is for the 1976 data and its content should be self explanatory.

The computer program that was developed for the data analysis greatly reduced the tedious job of tabulating data. The program was written so that it has to be run a separate time for each year of data. This allows for unlimited future use of the program by the State of Indiana except for a minor format alteration in later years for the contract year coding system. Also, the program provides for each data card to contain the required information for only one contract. This prevents mistakes in that contract data cannot be mixed up on cards as when two or more data points are on a single card. Finally, the program format was developed so that if future data divisions or methods of analysis are desired, they can be easily added by changing only a few cards. This versatility makes this computer program a valuable data analytic tool.

### 7.2 Penalty Breakdown by Year

One of the methods of analyzing the contract data was by contract year. The contract year is that year when the final payment was made to the contractor by the Indiana State Highway Commission whether an interest penalty occurred or not. The plot of Total Penalty versus Year can be seen in Figure 4. This figure clearly shows that from 1972 through 1977, the total penalty dollar amount increased dramatically. Also on this plot can be seen the increase in the number of contracts in which penalties occurred except for the same values in 1976 and 1977.



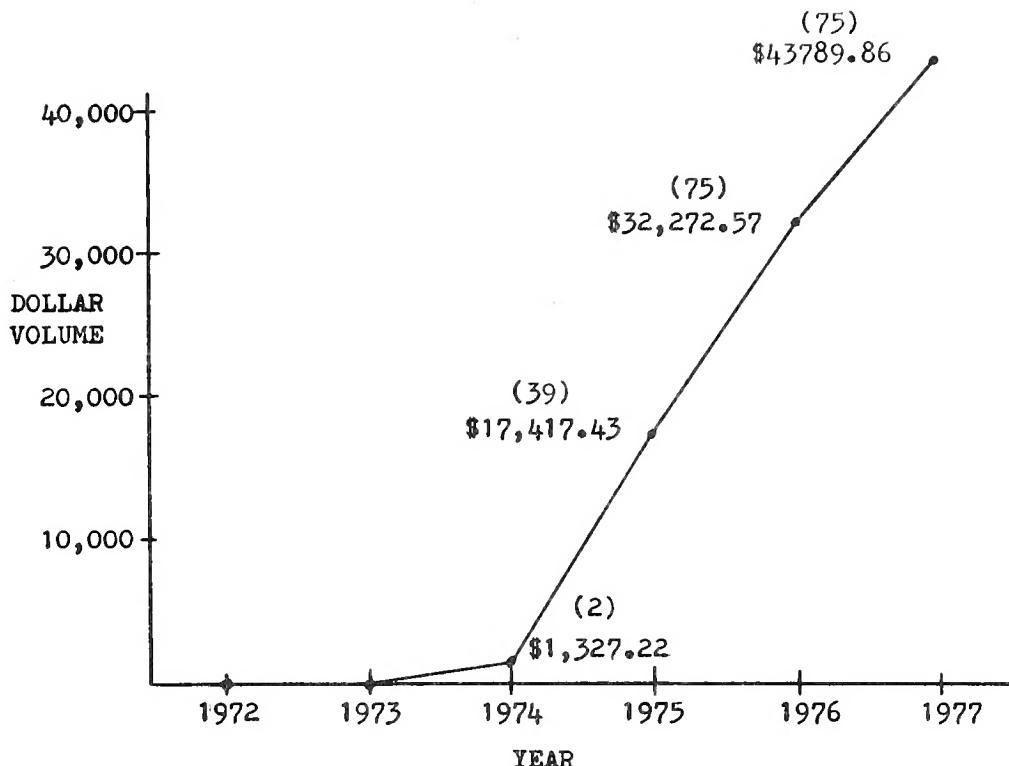


Figure 4

## TOTAL PENALTY VERSUS YEAR

Table 2

## PERCENT OF CONTRACTS WITH PENALTIES VERSUS YEAR

<u>YEAR</u>	<u>TOTAL NUMBER</u>	<u>NUMBER WITH PENALTIES</u>	<u>PERCENTAGE</u>
1972	119	0	0 %
1973	153	0	0 %
1974	163	2	1 %
1975	279	39	14 %
1976	355	75	21 %
1977	359	75	20 %



From the data compilation, it was known that from 1972 through 1977, the number of contracts let by the State of Indiana for highway related construction increased. Because of this, one might say that the increasing penalty amounts were due only to the increased number of contracts being performed; however, this is not the case. If one looks at the percentage of contracts in which penalties were paid each year with this percentage being based on the number of contracts in which penalties occurred divided by the total number of contracts in which final payments were made, it can be observed that this percentage increases from 1972 through 1976 and decreases by only one percent in 1977. Table 2, entitled Percent of Contracts With Penalties versus Year, shows this trend in penalty percentages. Therefore, the data shows that the State is paying fewer and fewer of its contracts on time.

The 1977 projections are based upon the following eight month data:

- a) Total Penalty- \$29193.24
- b) Number of Contracts with Penalties- 50
- c) Total Number of Contracts- 239

### 7.3 Penalty Breakdown by Contract Type

As was shown in the Computer Program Development section (7.1), there are five types of highway related construction contracts in the State of Indiana. They are the Road contract, the Bridge contract, the Road-Traffic contract, the Road-Surfacing contract, and the Road-Maintenance contract. An example of each along with its appropriate Indiana State Highway Commission coding symbol are as follows:



<u>CONTRACT TYPE</u>	<u>CODING SYMBOL</u>	<u>EXAMPLE</u>
Road	R	Continuous reinforced concrete paving on I-65
Bridge	B	Bridge erection over the Wabash River
Road-Traffic	RT	Installation of traffic signals in Lafayette, Indiana
Road-Surfacing	RS	Bituminous resurfacing on Route 38
Road-Maintenance	RM	Bridge painting in Tippecanoe county

When analyzing the 1972 through 1976 contract penalty data based on contract type, it again becomes apparent that the State of Indiana is making fewer final payments of its highway related contracts on time. Figures 5 through 9 are graphs of the total penalty for each contract type versus year. Tables 3 through 7 are tabulations of contract penalty percentage data for each type. It can be seen from the tables that the percentage of contracts up to 1976 in which penalties are being paid is increasing for each contract type except in Table 4 which pertains to Bridge contracts. This penalty percentage for bridges decreased slightly (2%) from 1975 to 1976. However, the other four contract types show a noticeable penalty percentage increase from year to year. The 1977 data, however, shows some improvement in that penalty dollar totals decreased for the Bridge, Road-Traffic, and Road-Maintenance contracts. Penalty percentages also decreased for the Road, Road-Traffic, Road Surfacing, and Road-Maintenance contracts.



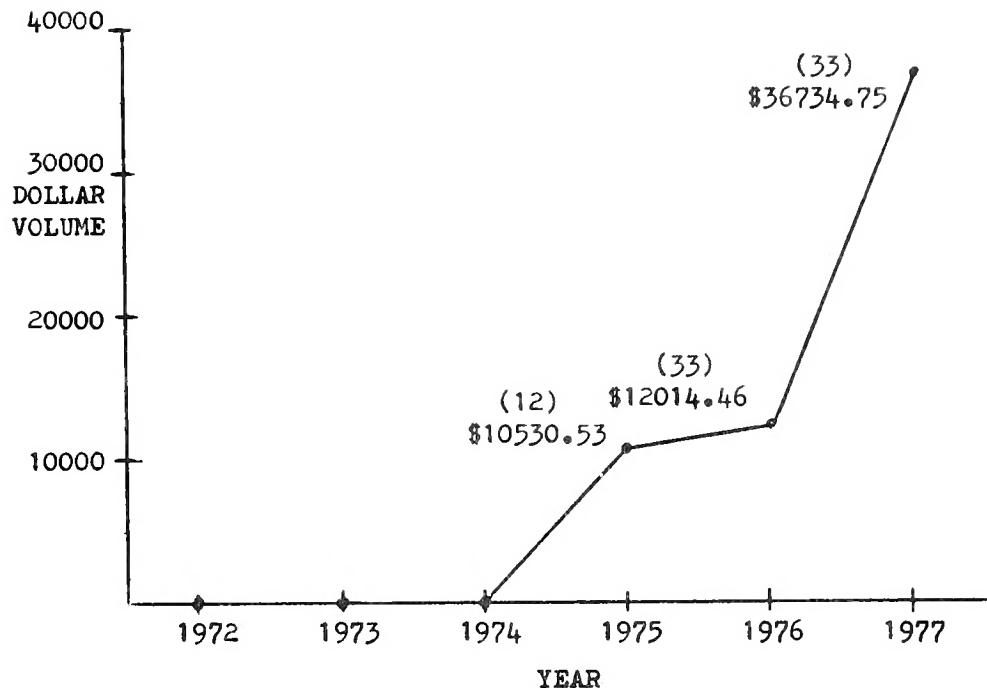


Figure 5

## TOTAL ROAD PENALTY VERSUS YEAR

Table 3

## PERCENT OF ROAD CONTRACTS WITH PENALTIES VERSUS YEAR

<u>YEAR</u>	<u>TOTAL NUMBER</u>	<u>NUMBER WITH PENALTIES</u>	<u>PERCENTAGE</u>
1972	60	0	0 %
1973	58	0	0 %
1974	52	0	0 %
1975	64	12	19 %
1976	94	33	35 %
1977	95	33	34 %



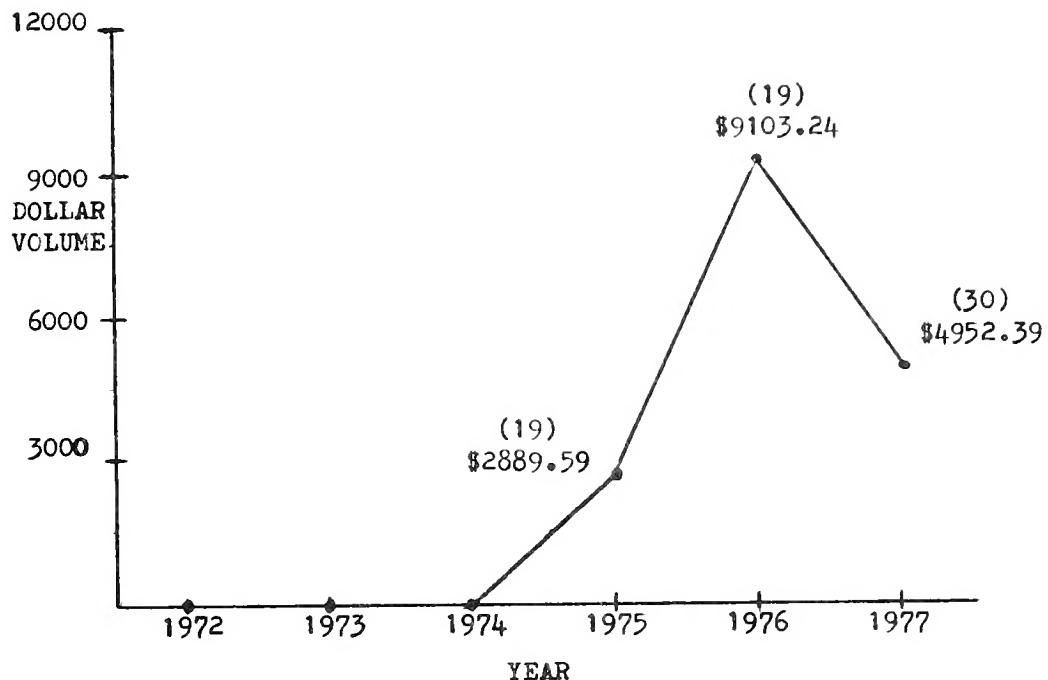


Figure 6

## TOTAL BRIDGE PENALTY VERSUS YEAR

Table 4

## PERCENT OF BRIDGE CONTRACTS WITH PENALTIES VERSUS YEAR

<u>YEAR</u>	<u>TOTAL NUMBER</u>	<u>NUMBER WITH PENALTIES</u>	<u>PERCENTAGE</u>
1972	54	0	0 %
1973	86	0	0 %
1974	68	0	0 %
1975	94	19	20 %
1976	107	19	18 %
1977	131	30	22 %



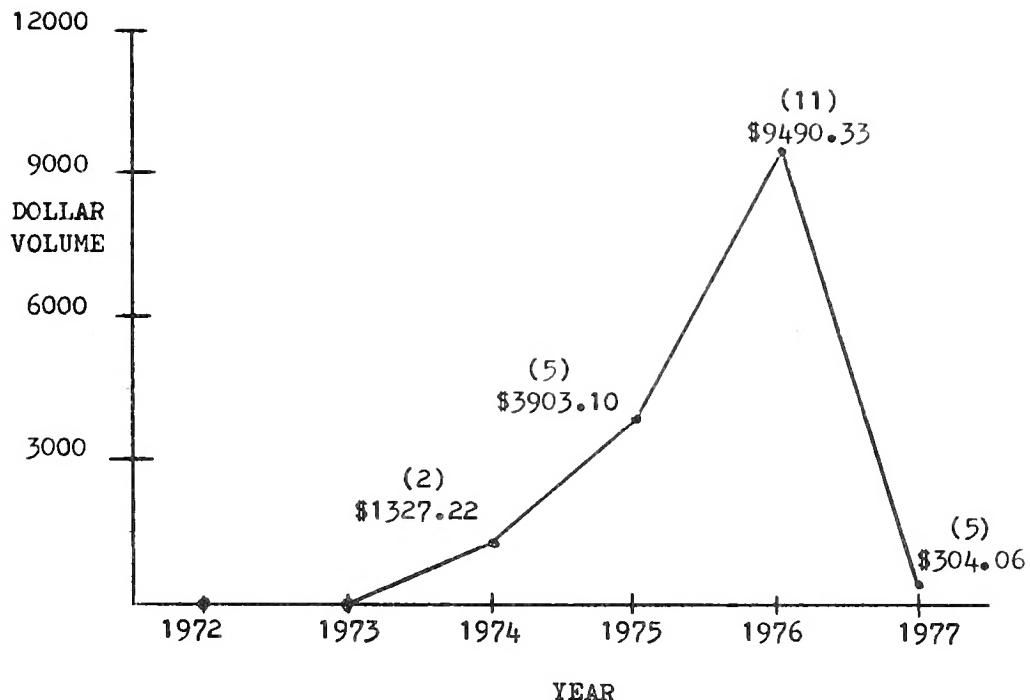


Figure 7

## TOTAL ROAD\*TRAFFIC PENALTY VERSUS YEAR

Table 5

## PERCENT OF ROAD\*TRAFFIC CONTRACTS WITH PENALTIES VERSUS YEAR

<u>YEAR</u>	<u>TOTAL NUMBER</u>	<u>NUMBER WITH PENALTIES</u>	<u>PERCENTAGE</u>
1972	5	0	0 %
1973	9	0	0 %
1974	17	2	12 %
1975	23	5	22 %
1976	36	11	31 %
1977	23	5	20 %



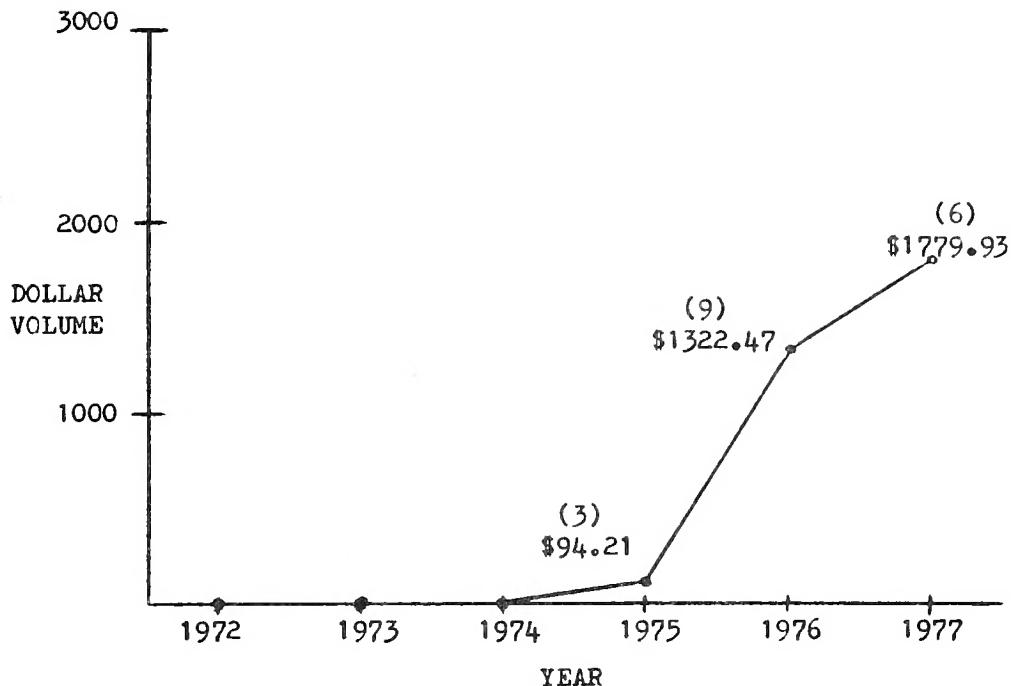


Figure 8

## TOTAL ROAD\*SURFACING PENALTY VERSUS YEAR

Table 6

## PERCENT OF ROAD\*SURFACING CONTRACTS WITH PENALTIES VERSUS YEAR

<u>YEAR</u>	<u>TOTAL NUMBER</u>	<u>NUMBER WITH PENALTIES</u>	<u>PERCENTAGE</u>
1972	0	0	0 %
1973	0	0	0 %
1974	23	0	0 %
1975	75	3	4 %
1976	76	9	12 %
1977	83	6	7 %



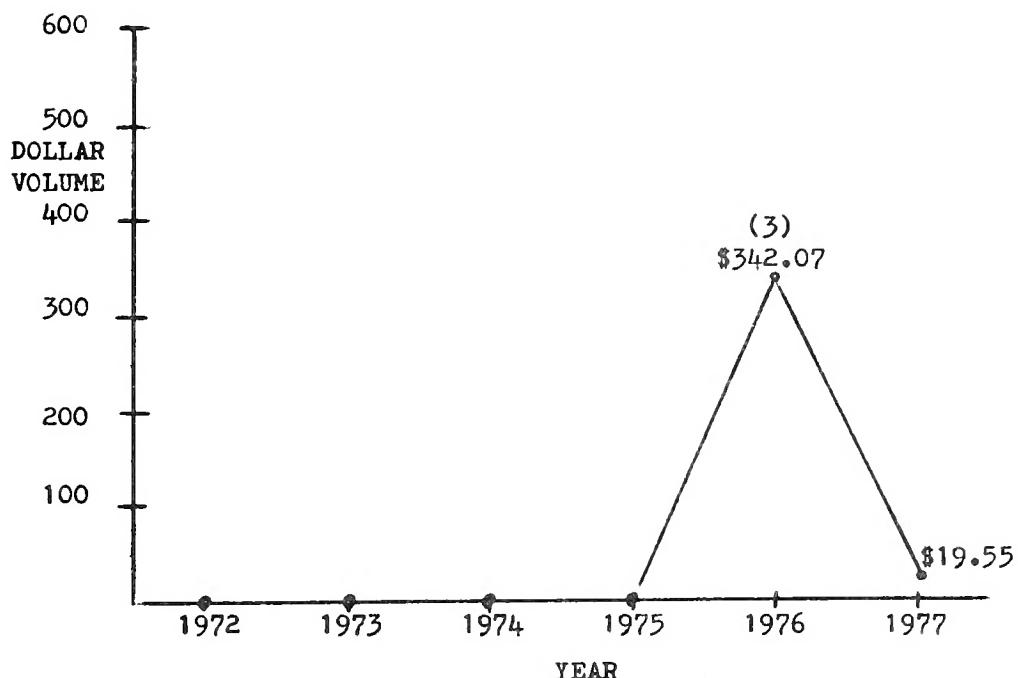


Figure 9

## TOTAL ROAD\*MAINTENANCE PENALTY VERSUS YEAR

Table 7

PERCENT OF ROAD\*MAINTENANCE CONTRACTS WITH PENALTIES VERSUS YEAR

<u>YEAR</u>	<u>TOTAL NUMBER</u>	<u>NUMBER WITH PENALTIES</u>	<u>PERCENTAGE</u>
1972	0	0	0 %
1973	0	0	0 %
1974	3	0	0 %
1975	23	0	0 %
1976	42	3	7 %
1977	29	2	5 %



The tabulations also show that Road contracts provide the highest chance of an interest penalty occurring. This percentage (35% in 1976) for Road contracts is closely followed by the percentage for Road-Traffic contracts (31% in 1976). The 1977 data illustrates this high percentage for Road contracts but they are followed this time by Bridge contracts. The reason why the Road contract penalty percentage is the highest for all contract types should be apparent. Road contracts entail many more work items than the other four types of contracts. Therefore, the typical Road contract provides for more paperwork for the project engineer of the contract, which leads to more needed checking by both the District Review Officer and the material certification personnel. The data then bears out the feeling of the researchers and the Indiana State Highway Commission officers that the hardest type of highway related construction contract for which a final payment will be made to the contractor on time is the Road contract. This opinion is also supported when looking at Figures 5 through 9 for the 1972 through 1977 contract data. For 1975, 1976, and 1977, the Road contract penalty dollar totals are much greater than any of the other four types of contracts.

When looking at the five graphs, it should also be apparent that all are climbing from 1972 through 1976. This helps to reinforce the fact that things are getting worse for the final construction contract payment procedure. For 1977, three of the five show a fall but the sharp increase in Road contract penalties outweighs all of the decreases.



From the analysis of the contract data based on contract type for 1972 through 1977, the researchers feel that project engineer experience should be taken into account when assigning contracts. It should be obvious that based on the difficulty of completing the contract's Construction Record, the more experienced project engineer should be given the Road contracts. The researchers feel that if the project engineer is unable to complete the Construction Record on time and satisfactorily, this insufficiency probably carries over into his daily work. Another study of this type might be to investigate the project engineer's ability to complete the Construction Record on time with the final quality of his project. This type of analysis might prove interesting to the State of Indiana.

The following eight month data is the basic for the 1977 projections shown on the tables and figures for the contract types:

a) Total Road contract penalty	- \$24489.83
b) Total Bridge contract penalty	- \$3301.59
c) Total Road-Traffic contract penalty	- \$202.17
d) Total Road-Surfacing contract penalty	- \$1186.62
e) Total Road-Maintenance contract penalty	- \$13.03
f) Total number of Road contracts	- 63
g) Total number of Bridge contracts	- 87
h) Total number of Road-Traffic contracts	- 15
i) Total number of Road-Surfacing contracts	- 55
j) Total number of Road-Maintenance contracts	- 19
k) Total number of Road contracts with penalties	- 22
l) Total number of Bridge contracts with penalties	- 20



- m) Total number of Road-Traffic contracts with penalties - 3
- n) Total number of Road-Surfacing contracts with penalties - 4
- o) Total number of Road-Maintenance contracts with penalties - - 1

#### 7.4 Penalty Breakdown by Contract Duration

Another way of analyzing the highway related contract data was by contract duration. Contract duration is the number of working days or calendar days that is allowed to the contractor by the State of Indiana to complete his work. Most contracts are usually issued on the work day basis due to holidays occurring during the anticipated work span or the possibility of inclement weather during the project. For this analysis, the researchers used the Indiana State Highway Commission contractual data which contains both the contract letting date and the number of working days allowed the contractor. A few of the contracts gave a completion date instead of the number of work days allowed but the number of work days between starting and finishing can be easily converted from the calendar days. For this analysis, considering Saturdays and Sundays but not considering legal holidays, it is assumed that there are 260 working days in a calendar year. Therefore, the contract duration breakdowns were by 130 working days which corresponds to six months of calendar days. It should be remembered that only those contracts in which interest penalties occurred were analyzed. Table 8 shows for each contract



Table 8

## PENALTY TOTALS AND PERCENTAGES VERSUS CONTRACT DURATION

DURATION	YEAR			
	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>
0-130 WD	\$1327.22 (2) 100%	\$9659.25 (24) 62%	\$9015.26 (36) 48%	\$8508.53 (35) 46%
131-260 WD	\$0.00 (0) 0%	\$7697.28 (14) 36%	\$15064.12 (36) 48%	\$32668.17 (30) 39%
261-390 WD	\$0.00 (0) 0%	\$60.90 (1) 3%	\$879.43 (1) 1%	\$1582.86 (8) 11%
391-520 WD	\$0.00 (0) 0%	\$0.00 (0) 0%	\$0.00 (0) 0%	\$1030.31 (3) 4%
521-650 WD	\$0.00 (0) 0%	\$0.00 (0) 0%	\$7313.76 (2) 3%	\$0.00 (0) 0%
≥ 651 WD	\$0.00 (0) 0%	\$0.00 (0) 0%	\$0.00 (0) 0%	\$0.00 (0) 0%

NOTE: Data for 1972 and 1973 is not included on this table since no interest penalties occurred during those two years.



duration breakdown, the penalty total amount, number of contracts making up this amount, and percentage of the total number of contracts with penalties for the year.

For the 1974 through 1977 data, it can be seen from Table 8 that the short contracts, namely those equal to or less than one year in duration, make up the highest percentage of contracts with penalties. This seems to contradict what is normally believed by Indiana State Highway Commission officials. They feel and the researchers concur in this belief that the short contracts normally have fewer work items and as a result should have less paperwork for the Construction Record connected to them. Therefore, they should present a smaller chance for possible interest penalties. However, as can be seen from the data on Table 8, this belief is soundly contradicted. The only reason the researchers can come up with for this is that the State of Indiana lets a higher percentage of short duration contracts in comparison to long contracts and because of this, more of the contracts with penalties are of short duration.

To arrive at the 1977 data on Table 8, the following eight month data was used:

- |   |      |
|---|------|
| a) Number of 1977 penalty contracts<br>of 0-130 working days duration   | - 23 |
| b) Number of 1977 penalty contracts<br>of 131-260 working days duration | - 20 |
| c) Number of 1977 penalty contracts<br>of 261-390 working days duration | - 5  |
| d) Number of 1977 penalty contracts<br>of 391-520 working days duration | - 2  |



e) Number of 1977 penalty contracts of 521-650 working days duration	-	0
f) Number of 1977 penalty contracts of equal to or greater than 651 working days duration	-	0
g) Penalty total of 1977 contracts of 0-130 working days duration	-	\$15672.35
h) Penalty total of 1977 contracts of 131-260 working days duration	-	\$21778.78
i) Penalty total of 1977 contracts of 261-390 working days duration	-	\$1055.24
j) Penalty total of 1977 contracts of 391-520 working days duration	-	\$686.87
k) Penalty total of 1977 contracts of 521-650 working days duration	-	\$0.00
l) Penalty total of 1977 contracts of equal to or greater than 651 working days duration	-	\$0.00

#### 7.5 Penalty Breakdown by Geographic District

The next way the contractual data was analyzed was by geographic district. As has been stated previously, the State of Indiana is comprised of six highway districts. Each is run by a separate district engineer and each has a District Review Officer who checks the Construction Records and who tries to keep the interest penalties as low as possible. Each district also performs all five types of contracts. Therefore, the researchers thought it might be interesting to compare districts as to their ability to pay the highway related construction contracts on time.

The data was analyzed by district in three ways. They were by penalty totals, by penalty percentage, and by the number of construction personnel in the district. The results of the first two



methods will be discussed in the following two paragraphs and then they will be followed by the construction personnel analysis.

Tables 9 through 14 show for each geographic district its interest penalty total for each year along with its penalty percentage. The penalty percentage was calculated by dividing the number of contracts in which penalties occurred by the total number of contracts in which final payment was made during the year. As can be seen on Table 11, the Greenfield district has the highest penalty total along with the highest penalty percentage for each of the years 1975, 1976, and 1977. The other five districts are not even close in their penalty percentages when compared to the Greenfield district. Another interesting result of the six tables is that they show that the penalty percentages increased each year for every district until the 1977 data where all but the Seymour district decreased. Also, it should be pointed out that the LaPorte district was the best district in terms of low interest penalties and percentages up through 1976. It was beaten by 2% in 1977 by the Vincennes district. These six tables show that the State of Indiana ought to be investigating its personnel in the Greenfield district to see why and because of whom the inefficiencies occur.

The 1977 data for district total penalties and percentages is based on the eight month data listed below:

- a) Penalty total in the Crawfordsville district - \$9467.18
- b) Penalty total in the Fort Wayne district - \$11468.70
- c) Penalty total in the Greenfield district - \$3268.17
- d) Penalty total in the LaPorte district - \$1334.80



Table 9

## CRAWFORDSVILLE DISTRICT PENALTY TOTALS AND PERCENTAGES

<u>YEAR</u>	<u>PENALTY TOTAL</u>	<u>TOTAL NUMBER</u>	<u>NUMBER WITH PENALTIES</u>	<u>PERCENTAGE</u>
1972	\$0.00	21	0	0%
1973	\$0.00	28	0	0%
1974	\$0.00	11	0	0%
1975	\$560.63	48	7	15%
1976	\$2996.25	43	12	28%
1977	\$14200.77	56	15	27%

Table 10

## FT. WAYNE DISTRICT PENALTY TOTALS AND PERCENTAGES

<u>YEAR</u>	<u>PENALTY TOTAL</u>	<u>TOTAL NUMBER</u>	<u>NUMBER WITH PENALTIES</u>	<u>PERCENTAGE</u>
1972	\$0.00	15	0	0%
1973	\$0.00	19	0	0%
1974	\$0.00	23	0	0%
1975	\$2545.59	36	4	11%
1976	\$2913.46	60	14	23%
1977	\$17203.05	45	9	20%



Table 11

## GREENFIELD DISTRICT PENALTY TOTALS AND PERCENTAGES

<u>YEAR</u>	<u>PENALTY TOTAL</u>	<u>TOTAL NUMBER</u>	<u>NUMBER WITH PENALTIES</u>	<u>PERCENTAGE</u>
1972	\$0.00	25	0	0%
1973	\$0.00	35	0	0%
1974	\$1259.31	25	1	4%
1975	\$6526.66	56	14	25%
1976	\$19366.54	57	24	42%
1977	\$4902.26	89	29	32%

Table 12

## LA PORTE DISTRICT PENALTY TOTALS AND PERCENTAGES

<u>YEAR</u>	<u>PENALTY TOTAL</u>	<u>TOTAL NUMBER</u>	<u>NUMBER WITH PENALTIES</u>	<u>PERCENTAGE</u>
1972	\$0.00	21	0	0%
1973	\$0.00	21	0	0%
1974	\$0.00	34	0	0%
1975	\$64.30	34	2	6%
1976	\$728.00	65	8	12%
1977	\$2002.23	41	3	7%



Table 13

## SEYMORE DISTRICT PENALTY TOTALS AND PERCENTAGES

<u>YEAR</u>	<u>PENALTY TOTAL</u>	<u>TOTAL NUMBER</u>	<u>NUMBER WITH PENALTIES</u>	<u>PERCENTAGE</u>
1972	\$0.00	19	0	0%
1973	\$0.00	33	0	0%
1974	\$0.00	35	0	0%
1975	\$6089.51	62	8	13%
1976	\$4621.83	65	10	15%
1977	\$5290.58	65	17	26%

Table 14

## VINCENNES DISTRICT PENALTY TOTALS AND PERCENTAGES

<u>YEAR</u>	<u>PENALTY TOTAL</u>	<u>TOTAL NUMBER</u>	<u>NUMBER WITH PENALTIES</u>	<u>PERCENTAGE</u>
1972	\$0.00	18	0	0%
1973	\$0.00	17	0	0%
1974	\$67.91	35	1	3%
1975	\$1630.84	43	4	9%
1976	\$1646.49	65	7	11%
1977	\$190.98	65	3	5%



e) Penalty total in the Seymour district	-	\$3527.05
f) Penalty total in the Vincennes district	-	\$127.32
g) Total number of contracts paid and the number with penalties in the Crawfordsville district	-	37,10
h) Total number of contracts paid and the number with penalties in the Fort Wayne district	-	30,6
i) Total number of contracts paid and the number with penalties in the Greenfield district	-	59,19
j) Total number of contracts paid and the number with penalties in the LaPorte district	-	27,2
k) Total number of contracts paid and the number with penalties in the Seymour district	-	43,11
l) Total number of contracts paid and the number with penalties in the Vincennes district	-	43,2

The third way of analyzing the highway related construction contract data by district is to consider the number of construction personnel working for the district each year. The Indiana State Highway Commission considers anyone with a Function 90 job code as a member of its construction personnel. All six geographic districts in the State of Indiana vary as to the number of construction personnel working in it. Indiana State Highway Commission officials felt that there might be a correlation between the number of State men working on the contracts and the total interest penalty for the contracts. They thought that the districts with fewer construction personnel would show the highest penalty amounts.



In order to investigate this opinion, the researchers had to get personnel data from the Indiana State Highway Commission's Personnel Office in Indianapolis. This office compiled the totals of all of the Function 90 personnel for each district for 1974, 1975, 1976, and up through August 31, 1977. This data can be seen on Tables 15 through 18.

Personnel data for 1972 and 1973 was not compiled since no penalties occurred those two years. Since all penalty totals for each district are based on the complete year, the researchers felt that it would be best to average the twelve monthly totals for each district to get a representative total for the year. These averages can be seen on the bottom row of each table.

In order to compare the geographic districts with respect to the number of construction men working in each district, the district interest penalty total for a year was divided by the average number of construction personnel working in that district during the year. The results of these calculations can be seen on Table 19. This table shows that in terms of dollars of interest penalty per construction man, the Greenfield district is the worst for years 1974 through 1976. This correlates with the data presented in the first part of this section. However, the Fort Wayne district is the worst in 1977 due to having a contract with an interest penalty over \$10000. This data also disproves the opinion of the Indiana State Highway Commission officials that those districts with fewer construction men would show a higher interest penalty cost per man. As can be seen from the 1975 and 1976 data on Table 19, the LaPorte district had



Table 15

## NUMBER OF EMPLOYEES IN CONSTRUCTION IN 1974

	DISTRICT					
	<u>CRAWFORDSVILLE</u>	<u>FT. WAYNE</u>	<u>GREENFIELD</u>	<u>LA PORTE</u>	<u>SEYMORE</u>	<u>VINCENNES</u>
JAN	101	75	142	88	189	174
FEB	100	72	142	86	187	174
MAR	97	72	142	87	185	172
APR	94	71	142	87	183	165
MAY	97	74	154	83	179	172
JUNE	108	99	157	88	187	174
JULY	108	115	207	89	208	193
AUG	120	118	209	88	211	192
SEPT	94	80	156	82	172	150
OCT	99	85	157	76	169	148
NOV	103	88	159	75	168	161
DEC	101	84	157	74	167	150
<u>AVG</u>	<u>102</u>	<u>86</u>	<u>160</u>	<u>84</u>	<u>184</u>	<u>169</u>



Table 16

## NUMBER OF EMPLOYEES IN CONSTRUCTION IN 1975

	DISTRICT					
	<u>CRAWFORDSVILLE</u>	<u>FT. WAYNE</u>	<u>GREENFIELD</u>	<u>LAPORTE</u>	<u>SEYMORE</u>	<u>VINCENNES</u>
JAN	100	85	157	75	182	149
FEB	97	86	152	75	181	151
MAR	98	86	148	74	177	150
APR	102	87	148	74	175	151
MAY	114	88	181	73	178	179
JUNE	113	108	194	74	185	187
JULY	116	120	224	74	200	184
AUG	122	119	231	78	198	186
SEPT	102	86	165	73	170	145
OCT	113	85	163	73	170	148
NOV	113	85	165	73	170	149
DEC	114	84	168	75	176	156
<u>AVG</u>	<u>109</u>	<u>92</u>	<u>175</u>	<u>74</u>	<u>180</u>	<u>161</u>



Table 17

## NUMBER OF EMPLOYEES IN CONSTRUCTION IN 1976

	DISTRICT					
	<u>CRAWFORDSVILLE</u>	<u>FT. WAYNE</u>	<u>GREENFIELD</u>	<u>LA PORTE</u>	<u>SEYMORE</u>	<u>VINCENNES</u>
JAN	115	84	166	74	176	155
FEB	---	--	---	--	---	---
MAR	114	84	163	73	175	154
APR	111	84	164	74	174	155
MAY	115	87	183	74	176	195
JUNE	120	103	185	79	181	192
JULY	131	107	193	79	193	191
AUG	130	128	192	74	197	186
SEPT	116	86	165	74	165	152
OCT	115	86	162	74	163	151
NOV	115	86	157	74	164	151
DEC	125	86	151	75	162	151
<u>AVG</u>	<u>119</u>	<u>93</u>	<u>171</u>	<u>75</u>	<u>175</u>	<u>167</u>



Table 18

## NUMBER OF EMPLOYEES IN CONSTRUCTION IN 1977

## DISTRICT

	<u>CRAWFORDSVILLE</u>	<u>FT. WAYNE</u>	<u>GREENFIELD</u>	<u>LA PORTE</u>	<u>SEYMOUR</u>	<u>VINCENNES</u>
JAN	123	85	149	75	160	146
FEB	123	85	146	75	160	145
MAR	122	85	146	74	160	142
APR	121	85	144	73	156	143
MAY	120	84	142	72	157	141
JUNE	157	130	161	87	159	145
JULY	158	130	160	87	158	141
AUG	152	126	167	85	157	143
<u>AVG</u>	<u>132</u>	<u>101</u>	<u>152</u>	<u>79</u>	<u>158</u>	<u>143</u>



Table 19

## INTEREST PENALTY DOLLARS PER CONSTRUCTION MAN

	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>
CRAWFORDSVILLE	\$0.00	\$5.14	\$25.18	\$105.19
FT. WAYNE	\$0.00	\$27.37	\$31.33	\$170.33
GREENFIELD	\$7.87	\$37.30	\$113.25	\$32.25
LA PORTE	\$0.00	\$0.87	\$9.71	\$25.34
SEYMORE	\$0.00	\$33.83	\$26.41	\$33.48
VINCENNES	\$0.40	\$10.13	\$9.86	\$1.34



the lowest interest penalty per man while it also had the lowest average number of construction men working during the year. Therefore, the data shows that a high number of construction personnel does not lead to a low interest penalty average.

#### 7.6 Penalty Breakdown by Project Engineer Type

Three types of project engineers participate in the final construction contract payment procedure-- namely, city, county, and state. Each is expected to complete a Construction Record for his project. It was mentioned by several Indiana State Highway Commission officers that they felt that their state project engineers were doing a much better job of completing the Construction Record on time in comparison to both city and county project engineers. It should be explained here that the city and county project engineers are not employed by the State of Indiana; they are supervising a project built in their city or county for their city or county government. Because of this, they usually have other duties to attend to for the city or county while they are at the same time supervising a project. Also, since they do not supervise a project all of the time, their experience in filling out Construction Records would be naturally less than that of the State of Indiana project engineer. With these thoughts in mind, the highway related contract data was analyzed according to project engineer type.

Tables 20 through 23 are tabulations of project engineer penalty percentages for 1974 through 1977. The two columns under each of the three types of engineers signify the number of contracts with penalties and the total number of contracts paid throughout the year.



Table 20

## 1974 PENALTY PERCENTAGES VERSUS PROJECT ENGINEER TYPE

<u>CONTRACT TYPE</u>	<u>CITY PENALTY TOTAL</u>		<u>COUNTY PENALTY TOTAL</u>		<u>STATE PENALTY TOTAL</u>	
ROAD	0	0	0	3	0	49
BRIDGE	0	0	0	11	0	57
ROAD- TRAFFIC	2	9	0	0	0	8
ROAD- SURFACING	0	0	0	0	0	23
ROAD- MAINTENANCE	0	0	0	0	0	3
 <b>TOTALS</b>	<b>2</b>	<b>9</b>	<b>0</b>	<b>14</b>	<b>0</b>	<b>140</b>
 <b>PERCENTAGE</b>	<b>22%</b>		<b>0%</b>		<b>0%</b>	

Table 21

## 1975 PENALTY PERCENTAGES VERSUS PROJECT ENGINEER TYPE

<u>CONTRACT TYPE</u>	<u>CITY PENALTY TOTAL</u>		<u>COUNTY PENALTY TOTAL</u>		<u>STATE PENALTY TOTAL</u>	
ROAD	0	0	1	4	11	60
BRIDGE	1	1	4	14	14	79
ROAD- TRAFFIC	1	13	0	0	4	10
ROAD- SURFACING	0	0	0	0	3	75
ROAD- MAINTENANCE	0	0	0	0	0	23
 <b>TOTALS</b>	<b>2</b>	<b>14</b>	<b>5</b>	<b>18</b>	<b>32</b>	<b>247</b>
 <b>PERCENTAGE</b>	<b>14%</b>		<b>28%</b>		<b>13%</b>	



Table 22

## 1976 PENALTY PERCENTAGES VERSUS PROJECT ENGINEER TYPE

<u>CONTRACT TYPE</u>	<u>CITY PENALTY TOTAL</u>		<u>COUNTY PENALTY TOTAL</u>		<u>STATE PENALTY TOTAL</u>	
	PENALTY	TOTAL	PENALTY	TOTAL	PENALTY	TOTAL
ROAD	6	11	1	3	26	80
BRIDGE	0	0	4	19	15	88
ROAD- TRAFFIC	8	11	0	0	3	25
ROAD- SURFACING	0	0	0	0	9	76
ROAD- MAINTENANCE	0	0	0	0	3	42
 <b>TOTALS</b>	<b>14</b>	<b>22</b>	<b>5</b>	<b>22</b>	<b>56</b>	<b>311</b>
 <b>PERCENTAGE</b>	<b>64%</b>		<b>23%</b>		<b>18%</b>	

Table 23

## 1977 PENALTY PERCENTAGES VERSUS PROJECT ENGINEER TYPE

<u>CONTRACT TYPE</u>	<u>CITY PENALTY TOTAL</u>		<u>COUNTY PENALTY TOTAL</u>		<u>STATE PENALTY TOTAL</u>	
	PENALTY	TOTAL	PENALTY	TOTAL	PENALTY	TOTAL
ROAD	3	6	5	5	26	84
BRIDGE	5	11	5	14	21	107
ROAD- TRAFFIC	3	5	0	0	2	18
ROAD- SURFACING	0	0	0	0	6	83
ROAD- MAINTENANCE	0	0	0	0	2	29
 <b>TOTALS</b>	<b>11</b>	<b>22</b>	<b>10</b>	<b>19</b>	<b>57</b>	<b>321</b>
 <b>PERCENTAGE</b>	<b>50%</b>		<b>53%</b>		<b>18%</b>	



At the bottom of each table are percentages which are the portion of the total number of contracts supervised by a certain project engineer type in which a penalty occurred. As can be seen for 1974, 1975, 1976, and 1977, the city and county project engineers caused a higher percentage of penalties than their State of Indiana counterparts. Therefore, the data agrees with the Indiana State Highway Commission officials' opinions. This data brings up again that it might be a good idea for the State of Indiana to have a meeting with its project engineers to discuss the proper procedure in filling out the Construction Record. It seems as though this could only lower the penalty percentages along with decreasing the penalty amount paid to the contractors each year.

Table 23 shows the projected 1977 project engineer penalty percentage data. It is based on the eight month data shown below:

- a) Total number of city, county, and state project - 4,3,56  
engineer Road contracts
- b) Total number of city, county, and state project - 7,9,71  
engineer Bridge contracts
- c) Total number of city, county, and state project - 3,0,12  
engineer Road-Traffic contracts
- d) Total number of city, county, and state project - 0,0,55  
engineer Road-Surfacing contracts
- e) Total number of city, county, and state project - 0,0,19  
engineer Road-Maintenance contracts
- f) Number of city, county, and state project - 2,3,17  
engineer Road contracts with penalties
- g) Number of city, county, and state project - 3,3,14  
engineer Bridge contracts with penalties
- h) Number of city, county, and state project - 2,0,1  
engineer Road-Traffic contracts with penalties



- i) Number of city, county, and state project engineer Road-Surfacing contracts with penalties - 0,0,4
- j) Number of city, county, and state project engineer Road-Maintenance contracts with penalties. - 0,0,1

### 7.7 Penalty History Analysis

Probably the most important section of the Data Analysis chapter is this one, the Penalty History Analysis. The discussions in the previous sections pointed out using numerical data that the State of Indiana does have a problem completing its final construction contract payment procedure within the 180 day limit and indicated where the problem areas lie. This section gives reasons for the late payment problems. It will show how the penalty reasons were analyzed, what the main reasons for interest penalties are, and will present a few suggestions on how to improve the procedure based on the penalty history analysis.

In order to look at the reasons for penalties, the first thing the researchers had to do was to look at all of the contracts in which final payments were made by the State of Indiana between the start of 1972 and August 31, 1977, and to group all of the contracts in which interest penalties occurred together. This was done using the contractual data supplied by the State of Indiana along with a history form devised by the researchers. For each contract in which an interest penalty was paid, the researchers compiled pertinent information about the contract in reference to reasons for the penalty on what the researchers call their History Analysis Form. A sample of this form can be seen in Figure 10. The data on this form



## CONTRACT R-08744

- 1) Seymour district (Dearborn county)
- 2) Penalty amount= \$1231.53
- 3) State project engineer
- 4) Contractor- Olinger Construction (Pre-grading)
- 5) Comments: a) Construction Record received in the Central Office 2 months and 28 days after the 180 day date.  
b) 10-31-75 IC727: Construction Record not received in the district office.  
c) 11-30-75 IC727: Construction Record not received in the district office.  
d) 12-31-75 IC727: Construction Record not received in the district office. The retainage was also dropped from 5% to 1%.  
e) 1-31-76 IC727: 50% checked by the district office.  
f) 2-29-76 IC727: Need the M-39 from the contractor and the Division of Materials and Tests' certification.  
g) 3-31-76 IC727: Need the Division of Materials and Tests' certification.  
h) 4-30-76 IC727: Need the Division of Materials and Tests' certification.

Last Working Day- 8-25-75

Acceptance Date - 8-25-75

180 Day Date - 2-21-76

Payment - 6-8-76

Note: It took the project engineer approximately four months to get the Construction Record to the district office. Division of Materials and Tests' certification also contributed to the penalty. The retainage reduction saved a lot of money.

Figure 10



is for the State of Indiana contract R-08744 in which a penalty occurred and final payment was made to the contractor in 1976.

Data for this form is derived from two Indiana State Highway Commission sources. The first is the monthly computer printout illustrated in Figure 2 which shows information on contracts completed and paid during the year along with those contracts still in progress. This printout supplies the required information for the following sections of the History Analysis Form:

- a) District and county the contract was performed in
- b) Penalty amount
- c) Type of project engineer
- d) Contractor and type of contract
- e) Last working day date
- f) Acceptance date
- g) 180 day date
- h) Final payment date

The second information source is the IC 727 form which the Indiana State Highway Commission entitles the Road and Bridge Construction Record Status Report. It should be pointed out here that this report also covers the other three types of highway related construction contracts. The IC 727 is issued monthly and it lists the status of each contract that has been completed and accepted but has not had its final payment sent to the contractor. This form shows what part of the final construction contract payment procedure the contract is in, along with reasons why the process is still in progress. The IC 727 form is used to complete the Comments Section of the



History Analysis Form along with the Note Section at the bottom.

The Note Section on the History Analysis Form is used as a summary. The analyst looks at the reasons for penalties in the Comments Section and states the primary reason or reasons for the penalty in the Notes Section. This saves time when a later numerical analysis just looks at the primary penalty reason.

As can be seen from Figure 10, the R-08744 contract had a substantial penalty-- \$1231.53. The two primary reasons for the penalty were that the project engineer turned the Construction Record into the District Office late, along with the late issuance of the Division of Materials and Tests certification. Also, it should be mentioned that a lot of money in interest penalties was saved by the State of Indiana on this contract when it dropped the contractor's retainage from 5% to 1%.

Every contract in which a penalty occurred since 1972 had a History Analysis Form filled out for it by the researchers. In doing this, it was noticed that there is a lack of uniformity on several of the items which make up the IC 727. These irregularities will be discussed separately in the following three paragraphs.

The first lack of uniformity is that of when the contract is first placed on the IC 727. In doing the history on each of the contracts with penalties, the researchers noticed that several of the contracts are not showing up on the IC 727 until a month or two before the 180 day payment period runs out. It seems as though it should be a mandatory requirement to put the contract on the IC 727 the month it is finally accepted. This would allow all



concerned to look at the IC 727 and know which accepted contracts have not been received in the District Office within one or two months after the start of the 180 day payment period. The responsible project engineer could then be notified of his lateness and fewer interest penalties should result.

The second lack of uniformity on the IC 727 deals with the Construction Record receipt in the District Office. A few of the districts show for each contract on the IC 727 the date the Construction Record was received in the District Office. This is a very good practice and should be a standard one throughout all six State of Indiana highway districts. By doing this routinely, it would be easy to determine which project engineers are submitting their Construction Records late. If it turns out to be a chronic problem for certain project engineers, then maybe it would be time to change personnel.

The third lack of uniformity pertains to penalty reasons. On several of the IC 727's, even though the contract is listed and the payment procedure is in progress, no note on its status was given. A monthly contract status update should be a requirement for all contracts. This would allow all personnel involved with the final construction contract payment procedure to discover the problems sooner and to take the necessary corrective actions to lower the amount of interest penalty paid to the contractor.

In completing the History Analysis Form for all of the contracts with penalties, several reasons for the contract penalties surfaced. The most prevalent reasons were listed in the Computer Program



Development section (7.1). This list of reasons contains four which illustrate delays due to the contractor. They are as follows:

- a) Need the M-39 from the contractor
- b) Need an approved IC 626 from the Central Office or the contractor
- c) Late issuance of the supplemental IT 611's
- d) Contractor protesting work day charges or approval of extension time

No penalty is paid by the State of Indiana due to this time charged to the contractor.

After completing the History Analysis Forms for all of the contracts with penalties from 1972 through August 31, 1977, the researchers were able to determine which reasons for contract penalties are the most prevalent. Two assumptions were necessary to complete this analysis; they are as follows:

- 1) If the project engineer took greater than two months after the contract acceptance date to get the Construction Record to the District Office, he contributed to the interest penalty.
- 2) If a reason shows up in the Comments Section of the History Analysis Form for two or more consecutive months, it contributed to the penalty.

With these two assumptions in mind, it should be realized that for each penalty contract, there can be more than one reason for the penalty. As will be seen on the penalty reason analysis data tables, the penalty reason percentages will add up to greater than 100%.



This is due to some contracts having more than one penalty reason.

Tables 24, 25, and 26 are the penalty reason analysis tabulations for 1975, 1976, and 1977. Only those reasons showing up equal to or greater than 10% of the time are placed on the tables. Also, data for 1972, 1973, and 1974 is not analyzed due to so few contracts with penalties during those years. All three tables show that the two primary reasons for interest penalties are project engineer lateness and late issuance of the Division of Materials and Tests certification. However, it should be stated that the tabulated percentages for these two reasons might actually be a little high. This is because both reasons sometimes involve extenuating circumstances. First, the project engineer is sometimes immediately sent to another job without time to adequately complete the Construction Record on the project he just completed. He then has to try to complete it while at the same time begin his new job. Secondly, sometimes when the Division of Materials and Tests is listed as not issuing its certification, it is waiting on an answer to a discrepancy letter or a material certification from the district. Therefore, these two excuses help to lower the penalty percentages somewhat but the fact still remains that project engineer lateness and the Division of Materials and Tests are the two main reasons for contract penalties up to now.

#### 7.8 Liquidated Damages Analysis

This final section of the Data Analysis chapter is different from those previously explained. The others showed where the State of Indiana's problems were in the final construction contract payment



Table 24

## 1975 PENALTY REASON ANALYSIS

<u>REASON FOR THE PENALTY</u>	<u>PERCENTAGE OF OCCURRENCES</u>
Project engineer turned in the Construction Record late	69%
Late issuance of the Division of Materials and Tests' certification	46%
Need the M-39 from the contractor	10%
Need an approved IC 626 from the Central office or the contractor	10%

Table 25

## 1976 PENALTY REASON ANALYSIS

<u>REASON FOR THE PENALTY</u>	<u>PERCENTAGE OF OCCURRENCES</u>
Project engineer turned in the Construction Record late	57%
Late issuance of the Division of Materials and Tests' certification	44%
Need the M-39 from the contractor	16%



Table 26  
1977 PENALTY REASON ANALYSIS

<u>REASON FOR THE PENALTY</u>	<u>PERCENTAGE OF OCCURRENCES</u>
Late issuance of the Division of Materials and Tests' certification	60%
Project engineer turned in the Construction Record late	54%
Late issuance of the District Office Materials' Certification	34%
Need M-39 from the contractor	16%
Project engineer turned in the Construction Record incomplete or with revisions required	14%
Late issuance of supplemental IT 611's	12%
Lengthy check in the district office	10%

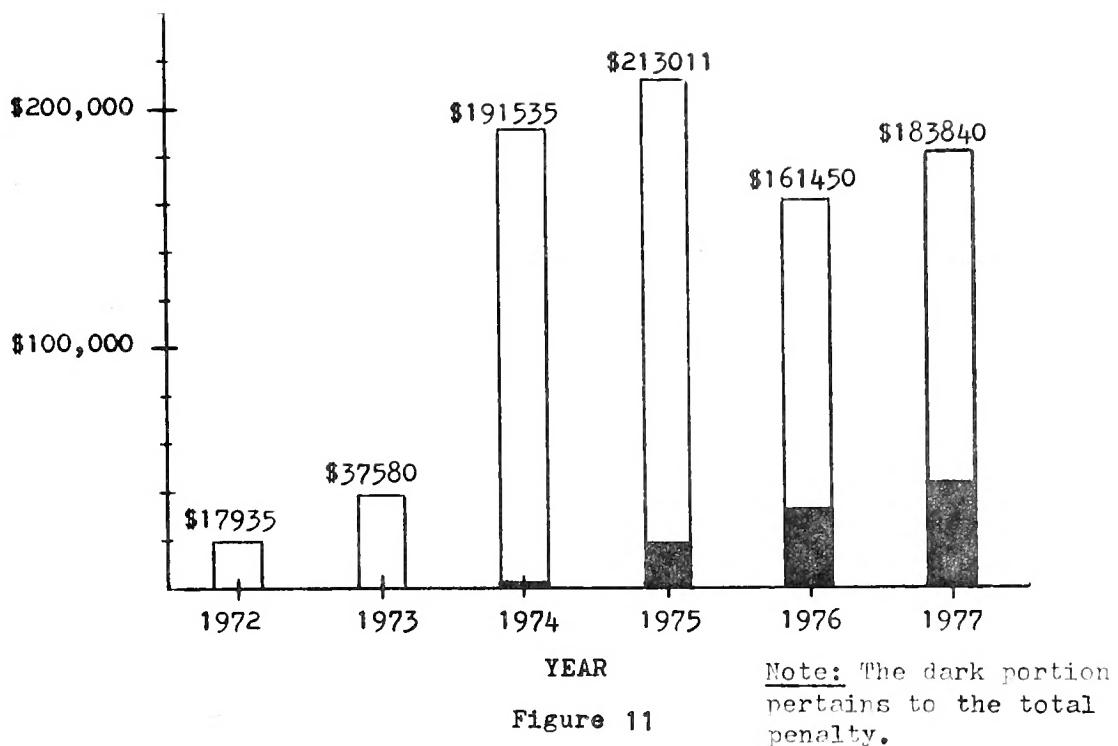


procedure in terms of contract type, contract duration, geographic district, or project engineer type. Liquidated damages are problem to the contractor, not the State of Indiana. A liquidated damage is that charge the contractor has to pay to the State of Indiana for completing the contract late. It is usually based on a charge per day late basis and this charge is multiplied by the number of days late to get the total amount of liquidated damages due the State of Indiana.

The researchers felt that it might be interesting to compare the liquidated damages received from the contractor to the interest penalties paid out to him for each year. This data can be seen in Figure 11. Below the figure is Table 27 which shows the total amount of liquidated damages for each year, the total number of contracts making up this total, and the average liquidated damage total for each year. The dark portion on Figure 11 pertains to total penalties.

As can be easily seen on Figure 11, the amount of liquidated damages paid by the contractor each year to the State of Indiana greatly exceeds the interest penalties expended. One could say therefore that interest penalties are not a serious problem to consider since the liquidated damages more than cancel them out. This opinion is wrong; the State of Indiana cannot depend on the contractor being late in his contract completion in order to pay for its interest penalties. Liquidated damages are good in that they provide extra revenue for the State of Indiana; however, they are bad in that the project is delayed and it might be more beneficial to the State of Indiana to have the project done sooner rather than becoming richer while the project sits unfinished.





LIQUIDATED DAMAGES VERSUS TOTAL PENALTY BAR CHART

Table 27

## LIQUIDATED DAMAGES VERSUS YEAR

<u>YEAR</u>	<u>TOTAL</u>	<u>NUMBER</u>	<u>AVERAGE</u>
1972	\$17935	13	\$1379.62
1973	\$37580	23	\$1633.91
1974	\$191535	36	\$5320.42
1975	\$213011	50	\$4260.22
1976	\$161450	36	\$4484.72
1977	\$183840	44	\$4178.18



The 1977 liquidated damages data are projections founded upon the following eight month data:

- a) Total liquidated damages in 1977 - \$122,60
- b) Number of contracts making up the liquidated damages in 1977 - 29



## CHAPTER 8

### CONCLUSIONS AND RECOMMENDATIONS

The following three sections list the researchers' conclusions and recommendations pertaining to the final construction contract payment procedure and the Construction Record Guide.

#### 8.1 Conclusions

The primary objective of this research paper was to provide an analysis of the final construction contract payment procedure of the Indiana State Highway Commission in order to give reasons, backed up by contract data, why the State of Indiana is having trouble paying its highway construction contracts on time. To carry out this analysis, the researcher had to investigate all of the components which make up the procedure. These are as follows: computation of final work item quantities using the Indiana State Highway Commission 1970 Construction Record Guide for Road, Bridge, Maintenance, and Traffic Contracts, completion of the Construction Record by the project engineer with these final work item quantities, checking of the Construction Record by the District Review Officer, and issuance of the materials' certifications. Another major aspect of the analysis was the compilation of highway construction contract data from 1972 through August 31, 1977. The data gathering provided proof that the State of Indiana does have difficulty paying its contracts on time and indicates how bad the problem actually is.



The major conclusion of the research is that the problem of late payment deals mainly with two groups of men who work for the State of Indiana. The first of these are the project engineers. Contract data shows that through the habits of some to put off the necessary paperwork related to the final construction contract payment procedure, the final payments due the contractor are paid late which results in a substantial yearly interest penalty. The second group to contribute to the difficulty of paying contracts on time is the personnel at the Division of Materials and Tests. Their cyclical organizational structure of paperwork flow has added many dollars to the interest penalty amount. However, they have in the past few months changed this organizational structure to a more hierarchical one, but it is too early for the data to show that the interest penalties will be decreasing because of this needed alteration.

This research paper's recommendations of how the final construction contract payment procedure can be improved along with those on improving the Indiana State Highway Commission 1970 Construction Record Guide for Road, Bridge, Maintenance, and Traffic Contracts can be found in the following two sections. They summarize both the opinions of the researchers along with the many District Review Officers and project engineers who were interviewed throughout the State of Indiana.

From the Data Analysis chapter, one can see that in terms of penalty dollars, the late payment problem has gotten worse every year. However, in terms of the percentage of contracts in which penalties were paid, there was an improvement as shown on the projected data for 1977.



Finally, it should be stated that the researchers feel that this area of interest penalties is a very important aspect of contractual interactions between the contractors and the State of Indiana. It has been said that the \$44,000 to be paid out in interest penalties this year is negligible when compared to the several millions the contracts were worth. However, a more important issue than money is at stake here. One's goal in construction is to provide the best project at the lowest possible cost. The Construction Record is the primary responsibility of the project engineer. A project engineer who neglects his paperwork and causes a penalty to be paid to the contractor is not only increasing the project's final cost, he is also costing the State in terms of time where he could be starting another job rather than finishing up his late paperwork. To strive to do one's best at something is admittedly much harder than to accept something less. However, to carry out inferior project management techniques, as do many of the project engineers, leads to a poor quality project at a high cost. Therefore, additional monitoring in this interest penalty area should be carried out in the future. The interest penalty total along with the appropriate reasons for penalties provide an excellent barometer of the quality of work being carried out in the State of Indiana and of the quality of its personnel.



8.2 Recommendation Summary Pertaining to the Final ConstructionContract Payment Procedure

The following is a compilation of the researchers' recommendations in reference to the final construction contract payment procedure of the Indiana State Highway Commission; all are elaborated upon in the text of this research paper. It is felt that using any or all of the recommendations will result in increased efficiency in the final construction contract payment procedure.

- 1) Institute a standard policy of District Review Officers issuing preliminary quantity IC 642's to the material certification laboratories only for problem work items (e.g. those with disputed quantities or those taking a long time to calculate).
- 2) Stop the practice of issuing Contractor's Inspection of the Final Construction Record Report (M-39) forms to the contractor prior to receipt of both material certifications.
- 3) Require all project engineers including city and county to attend periodic workshops on the preparation of Construction Records taught by District Review Officers.
- 4) Allow only the District Review Officer and a field-experienced assistant to check the Construction Records.
- 5) Set up an annual meeting between the six District Review Officers so they can discuss their problems and prevent procedural divergence.
- 6) Notify project engineers that the Recommended



Change in Plans, Materials, or Quantities (IC 626) forms can be completed by them with estimated quantities.

- 7) Allow District Review Officers to initiate retainage reductions.
- 8) Assign all project engineers an office assistant to help in the preparation of the Construction Record.
- 9) Encourage the Construction Record to be checked in sections throughout the job.
- 10) Work up a job description for the District Review Officers.
- 11) Require the project engineer to prepare his own Material Record (IT 611) forms each month in order to check the contractor.
- 12) Require all District Review Officers to be field-experienced and graduate civil engineers.
- 13) Stop the two distribution cycles at the Division of Materials and Tests by giving the Assistant to the Office Engineer a subordinate and let them do all of the material certification checking.
- 14) Require only a Division of Materials and Tests certification instead of also requiring the District Office Materials' Laboratory certification.
- 15) Require that all manufacturer's certifications be checked by the Division of Materials and Tests.
- 16) Computerize the checking procedure at the Division of Materials and Tests.
- 17) Require a contract completed during a month to be listed



on the next month's IC 727 form.

- 18) Require that the date the Construction Record arrives in the District Office is listed beside the contract on the IC 727 form.
- 19) Require that the status of each completed contract be listed for every month a contract is on the IC 727 form.

### 8.3 Recommendation Summary Pertaining to the Construction Record

#### Guide

Throughout the text of this research paper are recommendations which propose to improve the Indiana State Highway Commission 1970 Construction Record Guide for Road, Bridge, Maintenance, and Traffic Contracts. They were derived in order to aid the project engineer's preparation of the Construction Record along with facilitating the checking of it by the District Review Officer. The recommendations are compiled in this section to provide for easier reference. Therefore, the following recommendations developed from the research study pertain to the Construction Record Guide:

- 1) Make the corrections to the Construction Record Guide shown on the errata sheets in Appendix C.
- 2) Require the project engineers to reference their field book sketches more frequently rather than recopying them onto IC 614 forms.
- 3) Add a new section for Bridge Deck Repair Items.
- 4) Require all calculations to be carried out in work item quantities. This would remove the need for three forms of calculation accuracies.



- 5) In reference to contracts with federal funding, include a new section or incorporate Supplemental Instructions to Field Employees-No. 18 into the Construction Record Guide to show the project engineers how to handle this type of contract.
- 6) Do not require the usage of the IC 612B Pipe and Concrete Structures form if the same information it summarizes can be easily referenced in the project engineer's field book.
- 7) Computerize the dirt quantity calculations statewide. However, provide the District Review Officers with as-built cross section drawings so they can check the computer printout.
- 8) Do not require the usage of the IC 611A Pavement form if the same information it summarizes can be easily referenced in the project engineer's field book.
- 9) Place the new IC 654 Record of Construction (Concrete) form in the Construction Record Guide along with instructions of how it should be filled out.
- 10) Provide a work item example for Unclassified Excavation.
- 11) Provide a section in the Construction Record Guide showing the Central Office's opinion of the order of work items and forms to be included in the Construction Record.



LIST OF REFERENCES



## LIST OF REFERENCES

Indiana State Highway Commission. 1970 Construction Record Guide for Road, Bridge, Maintenance and Traffic Contracts.

Indiana State Highway Commission. General Instructions to Field Employees-Division of Construction, 1970.

Indiana State Highway Commission, Division of Materials and Tests. Manual for Frequency of Sampling & Testing and Basis for Use of Materials, April 1974.

Indiana State Highway Commission. Standard Specifications, 1974.



## **APPENDICES**



## *Appendix A*



## APPENDIX A

## COMPUTER PROGRAM

06/05/76 UNIVERSITY OF MINNESOTA FORTRAN PURDUE VERSION MOD NO. 3 PSR4.3 10/27/77 10:40:26  
MNF.

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C*   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C THIS PROGRAM WAS WRITTEN BY DAVID L. MAYS FOR HIS MASTERS
C THESIS ENTITLED AN INVESTIGATION OF THE FINAL CONSTRUCTION
C CONTRACT PAYMENT PROCEDURE FOR THE INDIANA STATE HIGHWAY
C COMMISSION. THE PROGRAM PROVIDES FOR A STATISTICAL ANALYSIS
C OF ALL HIGHWAY CONTRACTS FROM JANUARY 1972 TO THE PRESENT.
C*   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C THE EXPRESSION PERTAINING TO CONTRACT NAMES WILL BE C.
C*   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C THE FOLLOWING ARE THE 5 TYPES OF INDIANA HIGHWAY CONTRACTS**
C
C      1 R***ROAD
C      2 B***BRIDGE
C      3 RT***ROAD*TRAFFIC
C      4 RS***ROAD*SURFACING
C      5 RM***ROAD*MAINTENANCE
C
C THE EXPRESSION PERTAINING TO THE CONTRACT TYPES WILL BE IT.
C*   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C THE FOLLOWING ARE THE 3 TYPES OF INDIANA HIGHWAY CONTRACTS
C PERTAINING TO WHOSE ENGINEER IS IN CHARGE OF THE JOB**
C
C      1***CITY
C      2***COUNTY
C      3***STATE
C
C THE EXPRESSION PERTAINING TO THESE THREE TYPES WILL BE IC.
C*   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C THE EXPRESSION PERTAINING TO PENALTIES (INTEREST) WILL BE IP.
C THE DESIGNATION WILL BE AS FOLLOWS**
C
C      1***PENALTY WAS PAID
C      2***PENALTY WAS NOT REQUIRED
C*   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C THE EXPRESSION PERTAINING TO THE PENALTY AMOUNT WILL BE PA.
C*   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C THE FOLLOWING ARE THE 6 HIGHWAY DISTRICTS FOR INDIANA**
C
C      1***CRAFORDSVILLE
C      2***FORT WAYNE
C      3***GREENFIELD
C      4***LA PORTE
C      5***SEYMORE
C      6***VINCENNES
C
C THE EXPRESSION PERTAINING TO THE DISTRICTS WILL BE DJ.
C*   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C THE FOLLOWING ARE POSSIBLE REASONS FOR PENALTIES**
C
C      0***NO PENALTY
C      1***PROJECT ENGINEER TURNED IN THE DOCUMENTS LATE
C      2***LATE ISSUANCE OF THE CENTRAL OFFICE MATERIAL
C          CERTIFICATION
C      3***PROJECT ENGINEER TURNED IN THE DOCUMENTS
C          INCOMPLETE OR WITH REVISIONS REQUIRED
C      4***NEEDED THE H-39 FROM THE CONTRACTOR
C      5***NEED AN APPROVED IC 62B FROM THE CENTRAL OFFICE
C          OR THE CONTRACTOR
C      6***LENGTHY CHECK IN THE DISTRICT OFFICE
C      7***LATE ISSUANCE OF THE DISTRICT OFFICE MATERIAL
C          CERTIFICATION
C      8***LATE ISSUANCE OF THE SUPPLEMENTAL IT 611AS
C      9***LATE RECEIVAL OF A SIGN CERTIFICATION LETTER
C      10***LENGTHY PROCESSING BY IBM

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C   11***DELAY AT THE CENTRAL OFFICE (INDIANAPOLIS)
C   12***LATE ISSUANCE OF A CORE REPORT
C   13***CONTRACTOR PROTESTING WORK DAY CHARGES OR
C       APPROVAL OF EXTENSION TIME
C   14***HOLDING FOR LAB NUMBERS
C   15***WAITING FHWA APPROVAL FOR A TIME EXTENSION
C   . THE EXPRESSION PERTAINING TO THE REASONS FOR PENALTIES WILL BE IR.
C   . . . . .
C   . THE FOLLOWING ARE THE DESIGNATIONS FOR THE YEAR EACH CONTRACT
C   HAD THE FINAL ESTIMATE PAID.
C   . . . . .
C   2***1972
C   3***1973
C   4***1974
C   5***1975
C   6***1976
C   7***1977
C   . THE EXPRESSION PERTAINING TO THESE YEARS WILL BE IV.
C   . . . . .
C   . THIS PROGRAM IS DESIGNED AT PRESENT TO BE SEPARATELY RUN FOR
C   EACH YEAR FROM 1972 THRU 1977
C   . . . . .
C   N=TOTAL NUMBER OF CONTRACTS FOR THE YEAR
C   N1=NUMBER OF ROAD CONTRACTS FOR THE YEAR
C   N2=NUMBER OF ROAD CONTRACTS IN WHICH PENALTIES WERE PAID
C   N11=NUMBER OF ROAD CONTRACTS WITH A CITY PROJECT ENGINEER
C   N12=NUMBER OF CITY ROAD CONTRACTS IN WHICH PENALTIES WERE PAID
C   N13=NUMBER OF ROAD CONTRACTS WITH A COUNTY PROJECT ENGINEER
C   N14=NUMBER OF COUNTY ROAD CONTRACTS IN WHICH PENALTIES WERE PAID
C   N15=NUMBER OF ROAD CONTRACTS WITH A STATE PROJECT ENGINEER
C   N16=NUMBER OF STATE ROAD CONTRACTS IN WHICH PENALTIES WERE PAID
C   N17=NUMBER OF ROAD CONTRACTS IN DISTRICT 1
C   N18=NUMBER OF ROAD CONTRACTS IN DISTRICT 1 WITH PENALTIES
C   N19=NUMBER OF CITY ROAD CONTRACTS IN DISTRICT 1
C   N20=NUMBER OF CITY ROAD CONTRACTS IN DISTRICT 1 WITH PENALTIES
C   N21=NUMBER OF COUNTY ROAD CONTRACTS IN DISTRICT 1
C   N22=NUMBER OF COUNTY ROAD CONTRACTS IN DISTRICT 1 WITH PENALTIES
C   N23=NUMBER OF STATE ROAD CONTRACTS IN DISTRICT 1
C   N24=NUMBER OF STATE ROAD CONTRACTS IN DISTRICT 1 WITH PENALTIES
C   N25=NUMBER OF ROAD CONTRACTS IN DISTRICT 2
C   N26=NUMBER OF ROAD CONTRACTS IN DISTRICT 2 WITH PENALTIES
C   N27=NUMBER OF CITY ROAD CONTRACTS IN DISTRICT 2
C   N28=NUMBER OF CITY ROAD CONTRACTS IN DISTRICT 2 WITH PENALTIES
C   N29=NUMBER OF COUNTY ROAD CONTRACTS IN DISTRICT 2
C   N30=NUMBER OF COUNTY ROAD CONTRACTS IN DISTRICT 2 WITH PENALTIES
C   N31=NUMBER OF STATE ROAD CONTRACTS IN DISTRICT 2
C   N32=NUMBER OF STATE ROAD CONTRACTS IN DISTRICT 2 WITH PENALTIES
C   N33=NUMBER OF ROAD CONTRACTS IN DISTRICT 3
C   N34=NUMBER OF ROAD CONTRACTS IN DISTRICT 3 WITH PENALTIES
C   N35=NUMBER OF CITY ROAD CONTRACTS IN DISTRICT 3
C   N36=NUMBER OF CITY ROAD CONTRACTS IN DISTRICT 3 WITH PENALTIES
C   N37=NUMBER OF COUNTY ROAD CONTRACTS IN DISTRICT 3
C   N38=NUMBER OF COUNTY ROAD CONTRACTS IN DISTRICT 3 WITH PENALTIES
C   N39=NUMBER OF STATE ROAD CONTRACTS IN DISTRICT 3
C   N40=NUMBER OF STATE ROAD CONTRACTS IN DISTRICT 3 WITH PENALTIES
C   N41=NUMBER OF ROAD CONTRACTS IN DISTRICT 4
C   N42=NUMBER OF ROAD CONTRACTS IN DISTRICT 4 WITH PENALTIES
C   N43=NUMBER OF CITY ROAD CONTRACTS IN DISTRICT 4

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N44=NUMBER OF CITY ROAD CONTRACTS IN DISTRICT 4 WITH PENALTIES
N45=NUMBER OF COUNTY ROAD CONTRACTS IN DISTRICT 4
N46=NUMBER OF COUNTY ROAD CONTRACTS IN DISTRICT 4 WITH PENALTIES
N47=NUMBER OF STATE ROAD CONTRACTS IN DISTRICT 4
N48=NUMBER OF STATE ROAD CONTRACTS IN DISTRICT 4 WITH PENALTIES
N49=NUMBER OF ROAD CONTRACTS IN DISTRICT 5
N50=NUMBER OF ROAD CONTRACTS IN DISTRICT 5 WITH PENALTIES
N51=NUMBER OF CITY ROAD CONTRACTS IN DISTRICT 5
N52=NUMBER OF CITY ROAD CONTRACTS IN DISTRICT 5 WITH PENALTIES
N53=NUMBER OF COUNTY ROAD CONTRACTS IN DISTRICT 5
N54=NUMBER OF COUNTY ROAD CONTRACTS IN DISTRICT 5 WITH PENALTIES
N55=NUMBER OF STATE ROAD CONTRACTS IN DISTRICT 5
N56=NUMBER OF STATE ROAD CONTRACTS IN DISTRICT 5 WITH PENALTIES
N57=NUMBER OF ROAD CONTRACTS IN DISTRICT 6
N58=NUMBER OF ROAD CONTRACTS IN DISTRICT 6 WITH PENALTIES
N59=NUMBER OF CITY ROAD CONTRACTS IN DISTRICT 6
N60=NUMBER OF CITY ROAD CONTRACTS IN DISTRICT 6 WITH PENALTIES
N61=NUMBER OF COUNTY ROAD CONTRACTS IN DISTRICT 6
N62=NUMBER OF COUNTY ROAD CONTRACTS IN DISTRICT 6 WITH PENALTIES
N63=NUMBER OF STATE ROAD CONTRACTS IN DISTRICT 6
N64=NUMBER OF STATE ROAD CONTRACTS IN DISTRICT 6 WITH PENALTIES
* * * * * X=TOTAL PENALTY FOR ROAD CONTRACTS
X1=TOTAL PENALTY FOR CITY ROAD CONTRACTS
X2=TOTAL PENALTY FOR COUNTY ROAD CONTRACTS
X3=TOTAL PENALTY FOR STATE ROAD CONTRACTS
X4=TOTAL PENALTY FOR DISTRICT 1 ROAD CONTRACTS
X5=TOTAL PENALTY FOR DISTRICT 1 CITY ROAD CONTRACTS
X6=TOTAL PENALTY FOR DISTRICT 1 COUNTY ROAD CONTRACTS
X7=TOTAL PENALTY FOR DISTRICT 1 STATE ROAD CONTRACTS
X8=TOTAL PENALTY FOR DISTRICT 2 ROAD CONTRACTS
X9=TOTAL PENALTY FOR DISTRICT 2 CITY ROAD CONTRACTS
X10=TOTAL PENALTY FOR DISTRICT 2 COUNTY ROAD CONTRACTS
X11=TOTAL PENALTY FOR DISTRICT 2 STATE ROAD CONTRACTS
X12=TOTAL PENALTY FOR DISTRICT 3 ROAD CONTRACTS
X13=TOTAL PENALTY FOR DISTRICT 3 CITY ROAD CONTRACTS
X14=TOTAL PENALTY FOR DISTRICT 3 COUNTY ROAD CONTRACTS
X15=TOTAL PENALTY FOR DISTRICT 3 STATE ROAD CONTRACTS
X16=TOTAL PENALTY FOR DISTRICT 4 ROAD CONTRACTS
X17=TOTAL PENALTY FOR DISTRICT 4 CITY ROAD CONTRACTS
X18=TOTAL PENALTY FOR DISTRICT 4 COUNTY ROAD CONTRACTS
X19=TOTAL PENALTY FOR DISTRICT 4 STATE ROAD CONTRACTS
X20=TOTAL PENALTY FOR DISTRICT 5 ROAD CONTRACTS
X21=TOTAL PENALTY FOR DISTRICT 5 CITY ROAD CONTRACTS
X22=TOTAL PENALTY FOR DISTRICT 5 COUNTY ROAD CONTRACTS
X23=TOTAL PENALTY FOR DISTRICT 5 STATE ROAD CONTRACTS
X24=TOTAL PENALTY FOR DISTRICT 6 ROAD CONTRACTS
X25=TOTAL PENALTY FOR DISTRICT 6 CITY ROAD CONTRACTS
X26=TOTAL PENALTY FOR DISTRICT 6 COUNTY ROAD CONTRACTS
X27=TOTAL PENALTY FOR DISTRICT 6 STATE ROAD CONTRACTS
* * * * * NOTE*** THE DEFINITIONS ABOVE FOR THE N AND X VARIABLES ARE FOR
ROAD CONTRACTS. FOR THE OTHER CONTRACTS, THE SAME
DEFINITIONS APPLY EXCEPT THAT FOR BRIDGES, H AND Y ARE
USED, FOR ROAD TRAFFIC, L AND Z ARE USED, FOR
ROAD SURFACING, K AND V ARE USED, AND FOR ROAD MAINTENANCE
J AND U ARE USED.

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000000E      1.      DATA N,N1,N2,N11,N12,N13,N14,N15,N16/9*J/
002051J      2.      DATA N17,N18,N19,N20,N21,N22,N23,N24,N25,N26,N27,N28,N29/13*J/
002051O      3.      DATA N30,N31,N32,N33,N34,N35,N36,N37,N38,N39,N40,N41,N42/13*J/
002051B      4.      DATA N43,N44,N45,N46,N47,N48,N49,N50,N51,N52,N53,N54,N55/13*J/
002051L      5.      DATA N56,N57,N58,N59,N60,N61,N62,N63,N64/9*J/
002051L      6.      DATA X,X1,X2,X3,X4,X5,X6,X7,X8,X9,X10,X11,X12,X13,X14,X15/10*U.00/
002051S      7.      DATA X16,X17,X18,X19,X20,X21,X22,X23,X24,X25,X26,X27/12*J.00/
002051B      8.      DATA M1,M2,M11,M12,M13,M14,M15,M16/8*0/
002051B      9.      DATA M17,M18,M19,M20,M21,M22,M23,M24,M25,M26,M27,M28,M29/13*J/
002051I      10.     DATA M30,M31,M32,M33,M34,M35,M36,M37,M38,M39,M40,M41,M42/13*J/
002051S      11.     DATA M43,M44,M45,M46,M47,M48,M49,M50,M51,M52,M53,M54,M55/13*J/
002051J      12.     DATA M56,M57,M58,M59,M60,M61,M62,M63,M64/9*J/
002051B      13.     DATA Y,Y1,Y2,Y3,Y4,Y5,Y6,Y7,Y8,Y9,Y10,Y11,Y12,Y13,Y14,Y15/15*U.00/
002051B      14.     DATA Y16,Y17,Y18,Y19,Y20,Y21,Y22,Y23,Y24,Y25,Y26,Y27/12*U.00/
002051B      15.     DATA L1,L2,L11,L12,L13,L14,L15,L16/8*0/
002051B      16.     DATA L17,L18,L19,L20,L21,L22,L23,L24,L25,L26,L27,L28,L29/13*G/
002051S      17.     DATA L30,L31,L32,L33,L34,L35,L36,L37,L38,L39,L40,L41,L42/13*U/
002051S      18.     DATA L43,L44,L45,L46,L47,L48,L49,L50,L51,L52,L53,L54,L55/13*G/
002051S      19.     DATA L56,L57,L58,L59,L60,L61,L62,L63,L64/9*0/
002051S      20.     DATA Z,Z1,Z2,Z3,Z4,Z5,Z6,Z7,Z8,Z9,Z10,Z11,Z12,Z13,Z14,Z15/16*U.00/
002051S      21.     DATA Z16,Z17,Z18,Z19,Z20,Z21,Z22,Z23,Z24,Z25,Z26,Z27/12*U.00/
002051F      22.     DATA K1,K2,K11,K12,K13,K14,K15,K16/8*J/
002051L      23.     DATA K17,K18,K19,K20,K21,K22,K23,K24,K25,K26,K27,K28,K29/13*0/
002051L      24.     DATA K30,K31,K32,K33,K34,K35,K36,K37,K38,K39,K40,K41,K42/13*0/
002051L      25.     DATA K43,K44,K45,K46,K47,K48,K49,K50,K51,K52,K53,K54,K55/13*0/
002051L      26.     DATA K56,K57,K58,K59,K60,K61,K62,K63,K64/9*0/
002051L      27.     DATA V,V1,V2,V3,V4,V5,V6,V7,V8,V9,V10,V11,V12,V13,V14,V15/16*U.00/
002051L      28.     DATA V16,V17,V18,V19,V20,V21,V22,V23,V24,V25,V26,V27/12*U.00/
002051L      29.     DATA J1,J2,J11,J12,J13,J14,J15,J16/8*J/
002051S      30.     DATA J17,J18,J19,J20,J21,J22,J23,J24,J25,J26,J27,J28,J29/13*0/
002051S      31.     DATA J30,J31,J32,J33,J34,J35,J36,J37,J38,J39,J40,J41,J42/13*0/
002051S      32.     DATA J43,J44,J45,J46,J47,J48,J49,J50,J51,J52,J53,J54,J55/13*0/
002051L      33.     DATA J56,J57,J58,J59,J60,J61,J62,J53,J54/9*0/
002051L      34.     DATA U,U1,U2,U3,U4,U5,U6,U7,U8,U9,U10,U11,J12,J13,U14,U15/16*U.00/
002051S      35.     DATA U16,U17,U18,U19,U20,U21,U22,U23,U24,U25,U26,U27/12*U.00/
002051S      36.     PRINT 703
002722E      37.     703 FORMAT (F12.2U,X,ZCONTRACTS WITH PENALTIES,Z,8X,F PENALTY AMOUNTZ)
002722E      38.     100 READ 101,C,IT,ICE,IP,PA,IO,IR,TY
002736P      39.     101 FORMAT (A8,X,I2,X,I1,A,I1,X,F8.2,X,I1,X,I2,X,I1)
002736P      40.     IF (IT.EQ.0) GO TO 999
002737P      41.     IF (IP.EQ.1) GO TO 700
002740S      42.     702 N=N+1
002742S      43.     GO TO 704
002742S      44.     700 PRINT 701,C,PA
002751J      45.     701 FORMAT (/,25X,A8,22X,F8.2)
002751E      46.     GO TO 702
002751E      47.     704 IF (IT.EQ.1) GO TO 102
002753B      48.     IF (IT.EQ.2) GO TO 104
002755B      49.     IF (IT.EQ.3) GO TO 105
002756B      50.     IF (IT.EQ.4) GO TO 106
002760E      51.     IF (IT.EQ.5) GO TO 107
002761J      52.     GO TO 100
C*   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *
C* THE FOLLOWING STATEMENTS STATISTICALLY ANALYZE THE ROAD CONTRACTS
C*   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *
002762B      53.     102 N1=N1+1
002764J      54.     IF (IP.EQ.1) GO TO 103
0027666      55.     GO TO 112

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0027653      56.  103 N2=N2+1
0027703      57.  X=X+PA
C*   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *
C   THIS SECTION ANALYZES THE ROAD CONTRACTS BY CITY, COUNTY, OR
C   STATE PROJECT ENGINEER.
C*   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *
0027716      58.  112 IF (ICE.EQ.1) GO TO 113
0027736      59.  IF (ICE.EQ.2) GO TO 114
0027756      60.  IF (ICE.EQ.3) GO TO 115
0027766      61.  GO TO 117
0027776      62.  113 N11=N11+1
0030016      63.  IF (IP.EQ.1) GO TO 116
0030036      64.  GO TO 117
0030036      65.  116 N12=N12+1
0030056      66.  X1=X1+PA
0030066      67.  GO TO 117
0030076      68.  114 N13=N13+1
0030116      69.  IF (IP.EQ.1) GO TO 118
0030138      70.  GO TO 117
0030136      71.  118 N14=N14+1
0030153      72.  X2=X2+PA
0030166      73.  GO TO 117
0030176      74.  115 N15=N15+1
0030213      75.  IF (IP.EQ.1) GO TO 119
0030236      76.  GO TO 117
0030236      77.  119 N16=N16+1
0030256      78.  X3=X3+PA
C*   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *
C   THIS SECTION ANALYZES ROAD CONTRACTS BY DISTRICTS.
C*   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *
0030266      79.  117 IF (ID.EQ.1) GO TO 120
0030303      80.  IF (ID.EQ.2) GO TO 121
0030326      81.  IF (ID.EQ.3) GO TO 122
0030336      82.  IF (ID.EQ.4) GO TO 123
0030354      83.  IF (ID.EQ.5) GO TO 124
0030365      84.  IF (ID.EQ.6) GO TO 125
0030406      85.  GO TO 126
C*   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *
C           DISTRICT 1 ANALYSIS
C*   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *
0030416      86.  120 N17=N17+1
0030426      87.  IF (IP.EQ.1) GO TO 127
0030446      88.  GO TO 128
0030446      89.  127 N18=N18+1
0030466      90.  X4=X4+PA
0030478      91.  128 IF (ICE.EQ.1) GO TO 129
0030518      92.  IF (ICE.EQ.2) GO TO 130
0030538      93.  IF (ICE.EQ.3) GO TO 131
0030546      94.  GO TO 126
0030556      95.  129 N19=N19+1
0030576      96.  IF (IP.EQ.1) GO TO 132
0030618      97.  GO TO 126
0030618      98.  132 N20=N20+1
0030636      99.  X5=X5+PA
0030648     100.  GO TO 126
0030658     101.  130 N21=N21+1
0030676     102.  IF (IP.EQ.1) GO TO 133
0030713     103.  GO TO 126

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003071a 104. 133 N22=N22+1
003073b 105. X6=X6+PA
003074b 106. GO TO 12b
003075b 107. 131 N23=N23+1
003077c 108. IF (IP.EQ.1) GO TO 134
003101b 109. GO TO 126
003101b 110. 134 N24=N24+1
003103b 111. X7=X7+PA
003104b 112. GO TO 126
C*   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *
C*          DISTRICT 2 ANALYSIS
C*   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *
003105b 113. 121 N25=N25+1
003107b 114. IF (IP.EQ.1) GO TO 135
003111b 115. GO TO 136
003111b 116. 135 N26=N26+1
003113b 117. X8=X8+PA
003114b 118. 136 IF (ICE.EQ.1) GO TO 137
003115b 119. IF (ICE.EQ.2) GO TO 138
003120b 120. IF (ICE.EQ.3) GO TO 139
003121b 121. GO TO 126
003122b 122. 137 N27=N27+1
003124b 123. IF (IP.EQ.1) GO TO 140
003126b 124. GO TO 126
003126b 125. 140 N28=N28+1
003130b 126. X9=X9+PA
003131b 127. GO TO 126
003132b 128. 138 N29=N29+1
003134b 129. IF (IP.EQ.1) GO TO 141
003136b 130. GO TO 126
003136b 131. 141 N30=N30+1
003140b 132. X10=X10+PA
003141b 133. GO TO 12b
003142b 134. 139 N31=N31+1
003144b 135. IF (IP.EQ.1) GO TO 142
003146b 136. GO TO 126
003146b 137. 142 N32=N32+1
003150b 138. X11=X11+PA
003151b 139. GO TO 126
C*   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *
C*          DISTRICT 3 ANALYSIS
C*   *   *   *   *   *   *   *   *   *   *   *   *   *   *   *
003152b 140. 122 N33=N33+1
003154b 141. IF (IP.EQ.1) GO TO 143
003156b 142. GO TO 144
003156b 143. 143 N34=N34+1
003160b 144. X12=X12+PA
003161b 145. 144 IF (ICE.EQ.1) GO TO 145
003163b 146. IF (ICE.EQ.2) GO TO 146
003165b 147. IF (ICE.EQ.3) GO TO 147
003166b 148. GO TO 126
003167b 149. 145 N35=N35+1
003171b 150. IF (IP.EQ.1) GO TO 148
003173b 151. GO TO 126
003173b 152. 148 N36=N36+1
003175b 153. X13=X13+PA
003176b 154. GO TO 126
003177b 155. 146 N37=N37+1

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00320313 156. IF (IP.EQ.1) GO TO 149
0032036 157. GO TO 126
0032036 158. 149 N38=N38+1
003205e 159. X14=X14+PA
0032066 160. GO TO 126
0032073 161. 147 N39=N39+1
0032118 162. IF (IP.EQ.1) GO TO 150
0032133 163. GO TO 126
0032136 164. 150 N40=N40+1
0032158 165. X15=X15+PA
003216b 166. GO TO 126
C* * * * * * * * * * * * * * * * * * * * * * *
C* DISTRICT 4 ANALYSIS
C* * * * * * * * * * * * * * * * * * * * * * *
0032178 167. 123 N41=N41+1
0032213 168. IF (IP.EQ.1) GO TO 151
0032236 169. GO TO 152
003223b 170. 151 N42=N42+1
0032256 171. X16=X16+PA
003226b 172. 152 IF (ICE.EQ.1) GO TO 153
0032308 173. IF (ICE.EQ.2) GO TO 154
0032326 174. IF (ICE.EQ.3) GO TO 155
003233E 175. GO TO 126
0032348 176. 153 N43=N43+1
0032368 177. IF (IP.EQ.1) GO TO 156
0032443 178. GO TO 126
0032468 179. 156 N44=N44+1
0032466 180. X17=X17+PA
0032433 181. GO TO 126
0032446 182. 154 N45=N45+1
0032466 183. IF (IP.EQ.1) GO TO 157
0032508 184. GO TO 126
003250c 185. 157 N46=N46+1
003252E 186. X18=X18+PA
0032533 187. GO TO 126
0032546 188. 155 N47=N47+1
0032563 189. IF (IP.EQ.1) GO TO 158
0032608 190. GO TO 126
003260J 191. 158 N48=N48+1
0032628 192. X19=X19+PA
003263b 193. GO TO 126
C* * * * * * * * * * * * * * * * * * * * * * *
C* DISTRICT 5 ANALYSTS
C* * * * * * * * * * * * * * * * * * * * * * *
0032648 194. 124 N49=N49+1
003266b 195. IF (IP.EQ.1) GO TO 159
003270c 196. GO TO 160
0032708 197. 159 N50=N50+1
003272b 198. X20=X20+PA
003273d 199. 160 IF (ICE.EQ.1) GO TO 161
0032756 200. IF (ICE.EQ.2) GO TO 162
003277B 201. IF (ICE.EQ.3) GO TO 163
0033003 202. GO TO 126
0033015 203. 161 N51=N51+1
0033035 204. IF (IP.EQ.1) GO TO 164
003305c 205. GO TO 126
003305b 206. 164 N52=N52+1
0033078 207. X21=X21+PA

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003316U 208. GO TO 126
003317U 209. 162 N53=N53+1
003318U 210. IF (IP.EQ.1) GO TO 165
003319U 211. GO TO 126
003319S 212. 165 N54=N54+1
003317D 213. X22=X22+PA
003320D 214. GU TO 126
003321D 215. 163 N55=N55+1
003323S 216. IF (IP.EQ.1) GO TO 166
003325D 217. GO TO 126
003325S 218. 166 N56=N56+1
003327D 219. X23=X23+PA
003330D 220. GO TO 126
C* * * * * * * * * * * * * * * * * * * * * * * * *
C* * * * * * * * * * * * * * * * * * * * * * * * *
C* * * * * * * * * * * * * * * * * * * * * * * * *
C* * * * * * * * * * * * * * * * * * * * * * * * *
003331H 221. 125 N57=N57+1
003333L 222. IF (IP.EQ.1) GO TO 167
003335U 223. GO TO 168
003335S 224. 167 N58=N58+1
003337D 225. X24=X24+PA
003340D 226. 168 IF (ICE.EQ.1) GO TO 169
003342D 227. IF (ICE.EQ.2) GO TO 170
003344H 228. IF (ICE.EQ.3) GO TO 171
003345S 229. GO TO 126
003346S 230. 169 N59=N59+1
003350D 231. IF (IP.EQ.1) GO TO 172
003352E 232. GO TO 126
003352E 233. 172 N60=N60+1
003354S 234. X25=X25+PA
003355B 235. GO TO 126
003356B 236. 170 N61=N61+1
003360B 237. IF (IP.EQ.1) GO TO 173
003362B 238. GO TO 126
003362B 239. 173 N62=N62+1
003364B 240. X26=X26+PA
003365B 241. GO TO 126
003366B 242. 171 N63=N63+1
003370B 243. IF (IP.EQ.1) GO TO 174
003372B 244. GO TO 126
003372L 245. 174 N64=N64+1
003374B 246. X27=X27+PA
003375S 247. 126 GO TO 100
C* * * * * * * * * * * * * * * * * * * * * * * * *
C* THE FOLLOWING STATEMENTS STATISTICALLY ANALYZE THE BRIDGE
C* CONTRACTS
C* * * * * * * * * * * * * * * * * * * * * * * * *
003376B 248. 104 M1=M1+1
003400B 249. IF (IP.EQ.1) GO TO 175
003402S 250. GO TO 176
003402L 251. 175 M2=M2+1
003404E 252. Y=Y+PA
C* * * * * * * * * * * * * * * * * * * * * * * * *
C* THIS SECTION ANALYZES THE BRIDGE CONTRACTS BY CITY, COUNTY, OR
C* STATE PROJECT ENGINEER
C* * * * * * * * * * * * * * * * * * * * * * * * *
003405E 253. 176 IF (ICE.EQ.1) GO TO 177
003407B 254. IF (ICE.EQ.2) GO TO 178

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003411B      255.      IF ((CE.EQ.3) GO TO 179
003412E      256.      GO TO 180
003413B      257.      177 M11=M11+1
003415B      258.      IF ((IP.EQ.1) GO TO 181
0034175      259.      GO TO 180
0034176      260.      181 M12=M12+1
0034213      261.      Y1=Y1+PA
003422E      262.      GO TO 180
0034236      263.      178 M13=M13+1
003425B      264.      IF ((IP.EQ.1) GO TO 182
003427B      265.      GO TO 180
0034273      266.      182 M14=M14+1
003431B      267.      Y2=Y2+PA
0034325      268.      GO TO 180
003433E      269.      179 M15=M15+1
003435E      270.      IF ((IP.EQ.1) GO TO 183
0034373      271.      GO TO 180
0034376      272.      183 M16=M16+1
003441B      273.      Y3=Y3+PA
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C   THIS SECTION ANALYZES BRIDGE CONTRACTS BY DISTRICTS
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
003442B      274.      180 IF (IO.EQ.1) GO TO 184
003444B      275.      IF (IO.EQ.2) GO TO 185
003446B      276.      IF (IO.EQ.3) GO TO 186
003447B      277.      IF (IO.EQ.4) GO TO 187
003451B      278.      IF (IO.EQ.5) GO TO 188
003452B      279.      IF (IO.EQ.6) GO TO 189
003454B      280.      GO TO 190
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C   DISTRICT : ANALYSIS
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
003455B      281.      184 M17=M17+1
003456B      282.      IF ((IP.EQ.1) GO TO 191
003460B      283.      GO TO 192
003460E      284.      191 M18=M18+1
003462B      285.      Y4=Y4+PA
003463B      286.      192 IF((CE.EQ.1) GO TO 193
003465B      287.      IF ((CE.EQ.2) GO TO 194
003467B      288.      IF ((CE.EQ.3) GO TO 195
003470B      289.      GO TO 190
003471B      290.      193 M19=M19+1
003473B      291.      IF ((IP.EQ.1) GO TO 196
003475B      292.      GO TO 190
003475E      293.      196 M20=M20+1
003477B      294.      Y5=Y5+PA
003500B      295.      GO TO 190
003501B      296.      194 M21=M21+1
003503B      297.      IF ((IP.EQ.1) GO TO 197
003505B      298.      GO TO 190
003505E      299.      197 M22=M22+1
003507B      300.      Y6=Y6+PA
003510B      301.      GO TO 190
003511B      302.      195 M23=M23+1
003513B      303.      IF ((IP.EQ.1) GO TO 198
003515B      304.      GO TO 190
003515E      305.      198 M24=M24+1
003517B      306.      Y7=Y7+PA

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003520b      307.      GO TO 130
                C * * * * * * * * * * * * * * * * * * * * * * * * * * * *
                C * * * * * * * * * * * * * * * * * * * * * * * * * * * *
                C * * * * * * * * * * * * * * * * * * * * * * * * * * *
003521b      308.    185 M25=M25+1
003523b      309.    IF (IP.EQ.1) GO TO 199
003525b      310.    GO TO 200
003525L      311.    199 M26=M26+1
003527b      312.    Y8=Y8+PA
003530b      313.    200 IF (ICE.EQ.1) GO TO 201
003532b      314.    IF (ICE.EQ.2) GO TO 202
003534b      315.    IF (ICE.EQ.3) GO TO 203
003535b      316.    GO TO 190
003536b      317.    201 M27=M27+1
003540b      318.    IF (IP.EQ.1) GO TO 204
003542b      319.    GO TO 190
003542b      320.    204 M28=M28+1
003544b      321.    Y9=Y9+PA
003545b      322.    GO TO 190
003546b      323.    202 M29=M29+1
003550b      324.    IF (IP.EQ.1) GO TO 205
003552b      325.    GO TO 190
003552b      326.    205 M30=M30+1
Y10=Y10+PA
003554b      327.    GO TO 190
003555b      328.    GO TO 190
003556b      329.    203 M31=M31+1
003560b      330.    IF (IP.EQ.1) GO TO 206
003562b      331.    GO TO 190
003562b      332.    206 M32=M32+1
003564b      333.    Y11=Y11+PA
003565b      334.    GO TO 190
                C * * * * * * * * * * * * * * * * * * * * * * * * * * *
                C * * * * * * * * * * * * * * * * * * * * * * * * * * *
                C * * * * * * * * * * * * * * * * * * * * * * * * * * *
003566b      335.    186 M33=M33+1
003570b      336.    IF (IP.EQ.1) GO TO 207
003572b      337.    GO TO 208
003572b      338.    207 M34=M34+1
003574b      339.    Y12=Y12+PA
003575b      340.    208 IF (ICE.EQ.1) GO TO 209
003577b      341.    IF (ICE.EQ.2) GO TO 210
003580b      342.    IF (ICE.EQ.3) GO TO 211
003602b      343.    GO TO 190
003603b      344.    209 M35=M35+1
003605b      345.    IF (IP.EQ.1) GO TO 212
003607b      346.    GO TO 190
003607b      347.    212 M36=M36+1
003611b      348.    Y13=Y13+PA
003612b      349.    GO TO 190
003613b      350.    210 M37=M37+1
003615b      351.    IF (IP.EQ.1) GO TO 213
003617b      352.    GO TO 190
003617b      353.    213 M38=M38+1
003621b      354.    Y14=Y14+PA
003622b      355.    GO TO 190
003623b      356.    211 M39=M39+1
003625b      357.    IF (IP.EQ.1) GO TO 214
003627b      358.    GO TO 190

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003627c      359.    214 M40=M40+1
003631c      360.    Y15=Y15+PA
003632c      361.    GO TO 130
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
003633c      362.    187 M41=M41+1
003635c      363.    IF (IP.EQ.1) GO TO 215
003637c      364.    GU TO 216
003637c      365.    215 M42=M42+1
003641c      366.    Y16=Y16+PA
003642c      367.    216 IF (ICE.EQ.1) GO TO 217
003644c      368.    IF (ICE.EQ.2) GO TO 218
003646c      369.    IF (ICE.EQ.3) GO TO 219
003647c      370.    GU TO 190
003650c      371.    217 M43=M43+1
003652c      372.    IF (IP.EQ.1) GO TO 220
003654c      373.    GO TO 190
003654c      374.    220 M44=M44+1
003656c      375.    Y17=Y17+PA
003657c      376.    GO TO 190
003660c      377.    218 M45=M45+1
003662c      378.    IF (IP.EQ.1) GO TO 221
003663c      379.    GO TO 190
003664c      380.    221 M46=M46+1
003666c      381.    Y18=Y18+PA
003667c      382.    GO TO 190
003670c      383.    219 M47=M47+1
003672c      384.    IF (IP.EQ.1) GO TO 222
003674c      385.    GO TO 190
003674c      386.    222 M48=M48+1
003675c      387.    Y19=Y19+PA
003677c      388.    GO TO 190
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
003700c      389.    188 M49=M49+1
003702c      390.    IF (IP.EQ.1) GO TO 223
003704c      391.    GO TO 224
003704c      392.    223 M50=M50+1
003706c      393.    Y20=Y20+PA
003707c      394.    224 IF (ICE.EQ.1) GO TO 225
003711c      395.    IF (ICE.EQ.2) GO TO 226
003713c      396.    IF (ICE.EQ.3) GO TO 227
003714c      397.    GO TO 190
003717c      398.    225 M51=M51+1
003717c      399.    IF (IP.EQ.1) GO TO 229
003721c      400.    GO TO 190
003721c      401.    228 M52=M52+1
003723c      402.    Y21=Y21+PA
003724c      403.    GO TO 190
003725c      404.    226 M53=M53+1
003727c      405.    IF (IP.EQ.1) GO TO 229
003731c      406.    GO TO 190
003731c      407.    229 M54=M54+1
003733c      408.    Y22=Y22+PA
003734c      409.    GO TO 190
003735c      410.    227 M55=M55+1

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0037376 411.      IF (IP.EQ.1) GO TO 230
0037418 412.      GO TO 130
0037418 413.      230 M56=M56+1
0037435 414.      Y23=Y23+PA
0037448 415.      GO TO 130
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C           DISTRICT ANALYSIS
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
0037458 416.      189 M57=M57+1
0037476 417.      IF (IP.EQ.1) GO TO 231
0037516 418.      GO TO 232
0037516 419.      231 M58=M58+1
0037535 420.      Y24=Y24+PA
0037546 421.      232 IF (ICE.EQ.1) GO TO 233
0037565 422.      IF (ICE.EQ.2) GO TO 234
0037625 423.      IF (ICE.EQ.3) GO TO 235
0037616 424.      GO TO 130
0037620 425.      233 M59=M59+1
0037643 426.      IF (IP.EQ.1) GO TO 236
0037666 427.      GO TO 130
0037665 428.      236 M60=M60+1
0037735 429.      Y25=Y25+PA
0037718 430.      GO TO 130
0037726 431.      234 M61=M61+1
0037740 432.      IF (IP.EQ.1) GO TO 237
0037756 433.      GO TO 130
0037766 434.      237 M62=M62+1
0040000 435.      Y26=Y26+PA
0040013 436.      GO TO 130
0040026 437.      235 M63=M63+1
0040043 438.      IF (IP.EQ.1) GO TO 238
0040066 439.      GO TO 130
0040065 440.      238 M64=M64+1
0040101 441.      Y27=Y27+PA
0040116 442.      190 GO TO 100
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C           THE FOLLOWING STATEMENTS STATISTICALLY ANALYZE THE ROAD-TRAFFIC
C           CONTRACTS
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
0040126 443.      105 L1=L1+1
0040148 444.      IF (IP.EQ.1) GO TO 239
0040166 445.      GO TO 240
0040168 446.      239 L2=L2+1
0040206 447.      Z=Z+PA
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C           THIS SECTION ANALYZES THE ROAD-TRAFFIC CONTRACTS BY CITY,
C           COUNTY, OR STATE PROJECT ENGINEER
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
0040216 448.      240 IF (ICE.EQ.1) GO TO 241
0040236 449.      IF (ICE.EQ.2) GO TO 242
0040256 450.      IF (ICE.EQ.3) GO TO 243
0040268 451.      GO TO 244
0040276 452.      241 L11=L11+1
0040316 453.      IF (IP.EQ.1) GO TO 245
0040336 454.      GO TO 244
0040338 455.      245 L12=L12+1
0040356 456.      Z1=Z1+PA
0040363 457.      GO TO 244

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0040376      458.  242 L13=L13+1/
0040418      459.    IF (IP.EQ.1) GO TO 246
0040436      460.    GO TO 244
0040436      461.  246 L14=L14+1
0040456      462.    Z2=Z2+PA
0040466      463.    GO TO 244
0040476      464.  243 L15=L15+1
0040513      465.    IF (IP.EQ.1) GO TO 247
0040536      466.    GO TO 244
0040533      467.  247 L16=L16+1
0040556      468.    Z3=Z3+PA
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C   THIS SECTION ANALYZES ROAD TRAFFIC CONTRACTS BY DISTRICT
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
0040566      469.  244 IF (ID.EQ.1) GO TO 249
0040603      470.    IF (ID.EQ.2) GO TO 249
0040620      471.    IF (ID.EQ.3) GO TO 250
0040638      472.    IF (ID.EQ.4) GO TO 251
0040658      473.    IF (ID.EQ.5) GO TO 252
0040668      474.    IF (ID.EQ.6) GO TO 253
0040706      475.    GO TO 254
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C   DISTRICT 1 ANALYSIS
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
0040716      476.  248 L17=L17+1
0040723      477.    IF (IP.EQ.1) GO TO 255
0040743      478.    GO TO 256
0040746      479.  255 L18=L18+1
0040765      480.    Z4=Z4+PA
0040773      481.  256 IF (ICE.EQ.1) GO TO 257
0041013      482.    IF (ICE.EQ.2) GO TO 258
0041030      483.    IF (ICE.EQ.3) GO TO 259
0041040      484.    GO TO 254
0041053      485.  257 L19=L19+1
0041104      486.    IF (IP.EQ.1) GO TO 260
0041110      487.    GO TO 254
0041116      488.  260 L20=L20+1
0041133      489.    Z5=Z5+PA
0041140      490.    GO TO 254
0041150      491.  258 L21=L21+1
0041170      492.    IF (IP.EQ.1) GO TO 261
0041210      493.    GO TO 254
0041216      494.  261 L22=L22+1
0041230      495.    Z6=Z6+PA
0041246      496.    GO TO 254
0041256      497.  259 L23=L23+1
0041270      498.    IF (IP.EQ.1) GO TO 262
0041310      499.    GO TO 254
0041313      500.
0041316      501.  262 L24=L24+1
0041330      501.    Z7=Z7+PA
0041340      502.    GO TO 254
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C   DISTRICT 2 ANALYSIS
C   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
0041356      503.  249 L25=L25+1
0041370      504.    IF (IP.EQ.1) GO TO 263
0041416      505.    GO TO 254

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004141t 506. 263 L26=L26+1
004143b 507. Z8=Z8+PA
004144b 508. 264 IF (ICE.EQ.1) GO TO 265
004146L 509. IF (ICE.EQ.2) GO TO 266
004150b 510. IF (ICE.EQ.3) GO TO 267
004151c 511. GO TO 254
004152b 512. 265 L27=L27+1
004154b 513. IF (IP.EQ.1) GO TO 268
004156b 514. GO TO 254
004158c 515. 268 L28=L28+1
004160b 516. Z9=Z9+PA
004161b 517. GO TO 254
004162b 518. 266 L29=L29+1
004164b 519. IF (IP.EQ.1) GO TO 269
004166b 520. GO TO 254
004168b 521. 269 L30=L30+1
004170b 522. Z10=Z10+PA
004171b 523. GO TO 254
004172b 524. 267 L31=L31+1
004174b 525. IF (IP.EQ.1) GO TO 270
004176c 526. GO TO 254
004176b 527. 270 L32=L32+1
004200b 528. Z11=Z11+PA
004201b 529. GO TO 254
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C DISTRICT 3 ANALYSIS
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
004202b 530. 250 L33=L33+1
004204b 531. IF (IP.EQ.1) GO TO 271
004206b 532. GO TO 272
004208b 533. 271 L34=L34+1
004210b 534. Z12=Z12+PA
004211b 535. 272 IF (ICE.EQ.1) GO TO 273
004213b 536. IF (ICE.EQ.2) GO TO 274
004215b 537. IF (ICE.EQ.3) GO TO 275
004216c 538. GO TO 254
004217b 539. 273 L35=L35+1
004221b 540. IF (IP.EQ.1) GO TO 276
004223b 541. GO TO 254
004223b 542. 276 L36=L36+1
004225b 543. Z13=Z13+PA
004226b 544. GO TO 254
004227b 545. 274 L37=L37+1
004231b 546. IF (IP.EQ.1) GO TO 277
004233b 547. GO TO 254
004233b 548. 277 L38=L38+1
004235b 549. Z14=Z14+PA
004236b 550. GO TO 254
004237b 551. 275 L39=L39+1
004241b 552. IF (IP.EQ.1) GO TO 278
004243b 553. GO TO 254
004243b 554. 278 L40=L40+1
004245b 555. Z15=Z15+PA
004246b 556. GO TO 254
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C DISTRICT 4 ANALYSIS
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
004247b 557. 251 L41=L41+1

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004251c      554.      IF (IP.EQ.1) GO TO 279
004253b      559.      GO TO 280
004253j      560.      279 L42=L42+1
004255b      561.      Z16=Z16+PA
004256c      562.      280 IF (ICE.EQ.1) GO TO 281
004265j      563.      IF (ICE.EQ.2) GO TO 282
004262b      564.      IF (ICE.EQ.3) GO TO 283
004263b      565.      GO TO 254
004264b      566.      281 L43=L43+1
004265j      567.      IF (IP.EQ.1) GO TO 294
004270c      568.      GO TO 254
004270b      569.      282 L44=L44+1
004272c      570.      Z17=Z17+PA
004273b      571.      GO TO 254
004274b      572.      283 L45=L45+1
004276b      573.      IF (IP.EQ.1) GO TO 285
004300b      574.      GO TO 254
004300b      575.      285 L46=L46+1
004302b      576.      Z18=Z18+PA
004303b      577.      GO TO 254
004304b      578.      283 L47=L47+1
004306b      579.      IF (IP.EQ.1) GO TO 286
004310b      580.      GO TO 254
004310c      581.      286 L48=L48+1
004312b      582.      Z19=Z19+PA
004313b      583.      GO TO 254
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C                               DISTRICT 5 ANALYSIS
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
004314b      584.      252 L49=L49+1
004315j      585.      IF (IP.EQ.1) GO TO 287
004320b      586.      GO TO 288
004320b      587.      287 L50=L50+1
004322b      588.      Z20=Z20+PA
004323b      589.      288 IF (ICE.EQ.1) GO TO 289
004325b      590.      IF (ICE.EQ.2) GO TO 290
004327b      591.      IF (ICE.EQ.3) GO TO 291
004330b      592.      GO TO 254
004331b      593.      289 L51=L51+1
004333b      594.      IF (IP.EQ.1) GO TO 292
004335b      595.      GO TO 254
004335b      596.      292 L52=L52+1
004337b      597.      Z21=Z21+PA
004340b      598.      GO TO 254
004341b      599.      290 L53=L53+1
004343b      600.      IF (IP.EQ.1) GO TO 293
004345b      601.      GO TO 254
004345b      602.      293 L54=L54+1
004347b      603.      Z22=Z22+PA
004350b      604.      GO TO 254
004351b      605.      291 L55=L55+1
004353b      606.      IF (IP.EQ.1) GO TO 294
004355b      607.      GO TO 254
004355b      608.      294 L56=L56+1
004357b      609.      Z23=Z23+PA
004360b      610.      GO TO 254
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C                               DISTRICT 6 ANALYSIS

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C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
0043616      b11.   253 L57=L57+1
0043635      b12.   IF (IP.EQ.1) GO TO 295
0043656      b13.   GO TO 296
0043653      b14.   295 L58=L58+1
004367E      b15.   Z24=Z24+PA
0043703      b16.   296 IF (ICE.EQ.1) GO TO 247
0043726      b17.   IF (ICE.EQ.2) GO TO 298
0043746      b18.   IF (ICE.EQ.3) GO TO 299
004375E      b19.   GO TO 254
004375L      b20.   297 L59=L59+1
0044013      b21.   IF (IP.EQ.1) GO TO 300
0044026      b22.   GO TO 254
0044023      b23.   300 L60=L60+1
004404E      b24.   Z25=Z25+PA
0044053      b25.   GO TO 254
0044056      b26.   298 L61=L61+1
0044116      b27.   IF (IP.EQ.1) GO TO 301
004412E      b28.   GO TO 254
004412E      b29.   301 L62=L62+1
0044146      b30.   Z26=Z26+PA
0044156      b31.   GO TO 254
0044163      b32.   299 L63=L63+1
0044203      b33.   IF (IP.EQ.1) GO TO 302
0044226      b34.   GO TO 254
0044223      b35.   302 L64=L64+1
004425E      b36.   Z27=Z27+PA
004425L      b37.   254 GO TO 100
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C THE FOLLOWING STATEMENTS STATISTICALLY ANALYZE THE ROAD-SURFACING
C CONTRACTS
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
0044265      638.   106 K1=K1+1
0044316      639.   IF (IP.EQ.1) GO TO 303
0044326      640.   GO TO 304
0044326      641.   303 K2=K2+1
0044346      642.   V=V+PA
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C THIS SECTION ANALYZES THE ROAD-SURFACING CONTRACTS BY CITY,
C COUNTY, OR STATE PROJECT ENGINEER
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
004435L      643.   304 IF (ICE.EQ.1) GO TO 305
0044376      644.   IF (ICE.EQ.2) GO TO 306
0044413      645.   IF (ICE.EQ.3) GO TO 307
0044416      646.   "
0044426      647.   GO TO 308
0044438      647.   305 K11=K11+1
0044453      648.   IF (IP.EQ.1) GO TO 309
0044478      649.   GO TO 308
004447L      650.   309 K12=K12+1
004451L      651.   V1=V1+PA
0044526      652.   GO TO 308
0044533      653.   306 K13=K13+1
0044558      654.   IF (IP.EQ.1) GO TO 310
004457E      655.   GO TO 308
0044576      656.   310 K14=K14+1
0044613      657.   V2=V2+PA
0044626      658.   GO TO 308

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004463E 659. 307 K15=K15+1
004465E 660. IF (IP.EQ.1) GO TO 311
0044673 661. GO TO 308
004467D 662. 311 K16=K16+1
004471E 663. V3=V3+PA
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C THIS SECTION ANALYZES ROAD SURFACING CONTRACTS BY DISTRICTS
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
004472B 664. 308 IF (ID.EQ.1) GO TO 312
004474E 665. IF (ID.EQ.2) GO TO 313
004476B 666. IF (ID.EQ.3) GO TO 314
0044775 667. IF (ID.EQ.4) GO TO 315
004501L 668. IF (ID.EQ.5) GO TO 316
004502G 669. IF (ID.EQ.6) GO TO 317
004504G 670. GO TO 318
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C DISTRICT 1 ANALYSIS
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
004505L 671. 312 K17=K17+1
004506L 672. IF (IP.EQ.1) GO TO 319
004510S 673. GO TO 320
004510G 674. 319 K18=K18+1
004512L 675. V4=V4+PA
004513S 676. 320 IF (ICE.EQ.1) GO TO 321
004515L 677. IF (ICE.EQ.2) GO TO 322
0045173 678. IF (ICE.EQ.3) GO TO 323
004520L 679. GO TO 318
004521D 680. 321 K19=K19+1
004523D 681. IF (IP.EQ.1) GO TO 324
004525G 682. GO TO 318
004525E 683. 324 K20=K20+1
004527E 684. V5=V5+PA
004530S 685. GO TO 318
004531B 686. 322 K21=K21+1
004533H 687. IF (IP.EQ.1) GO TO 325
004535G 688. GO TO 318
004535S 689. 325 K22=K22+1
0045373 690. V6=V6+PA
004540G 691. GO TO 318
004541L 692. 323 K23=K23+1
004543C 693. IF (IP.EQ.1) GO TO 326
004545G 694. GO TO 318
004549B 695. 326 K24=K24+1
004547E 696. V7=V7+PA
004550B 697. GO TO 318
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C DISTRICT 2 ANALYSIS
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
004551B 698. 313 K25=K25+1
004553J 699. IF (IP.EQ.1) GO TO 327
004555E 700. GO TO 328
0045553 701. 327 K26=K26+1
0045576 702. V8=V8+PA
004560G 703. 328 IF (ICE.EQ.1) GO TO 329
004562E 704. IF (ICE.EQ.2) GO TO 330
004564B 705. IF (ICE.EQ.3) GO TO 331
004565G 706. GO TO 318
004566J 707. 329 K27=K27+1

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0045706    709.      IF ((P.EQ.1) GO TO 332
0045725    709.      GO TO 318
0045725    710.      332 K28=K28+1
0045740    711.      V9=V9+PA
0045750    712.      GO TO 318
0045763    713.      330 K29=K29+1
0046000    714.      IF ((P.EQ.1) GO TO 333
0046023    715.      GO TO 318
0046025    716.      333 K30=K30+1
0046040    717.      V10=V10+PA
0046050    718.      GO TO 318
0046050    719.      331 K31=K31+1
0046110    720.      IF ((P.EQ.1) GO TO 334
0046120    721.      GO TO 318
0046125    722.      334 K32=K32+1
0046140    723.      V11=V11+PA
0046170    724.      GO TO 318
C * * * * * DISTRICT 3 ANALYSIS
C * * * * *
0046160    725.      314 K33=K33+1
0046200    726.      IF ((P.EQ.1) GO TO 335
0046220    727.      GO TO 336
0046220    728.      335 K34=K34+1
0046240    729.      V12=V12+PA
0046250    730.      336 IF ((ICE.EQ.1) GO TO 337
0046270    731.      IF ((ICE.EQ.2) GO TO 338
0046310    732.      IF ((ICE.EQ.3) GO TO 339
0046320    733.      GO TO 318
0046330    734.      337 K35=K35+1
0046350    735.      IF ((P.EQ.1) GO TO 340
0046370    736.      GO TO 318
0046370    737.      340 K36=K36+1
0046410    738.      V13=V13+PA
0046420    739.      GO TO 318
0046430    740.      338 K37=K37+1
0046450    741.      IF ((P.EQ.1) GO TO 341
0046470    742.      GO TO 318
0046470    743.      341 K38=K38+1
0046510    744.      V14=V14+PA
0046520    745.      GO TO 318
0046530    746.      339 K39=K39+1
0046550    747.      IF ((P.EQ.1) GO TO 342
0046570    748.      GO TO 318
0046570    749.      342 K40=K40+1
0046610    750.      V15=V15+PA
0046620    751.      GO TO 318
C * * * * * DISTRICT 4 ANALYSIS
C * * * * *
0046630    752.      315 K41=K41+1
0046630    753.      IF ((P.EQ.1) GO TO 343
0046670    754.      GO TO 344
0046670    755.      343 K42=K42+1
0046710    756.      V16=V16+PA
0046720    757.      344 IF ((ICE.EQ.1) GO TO 345
0046740    758.      IF ((ICE.EQ.2) GO TO 346
0046760    759.      IF ((ICE.EQ.3) GO TO 347

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0046776    760.      GO TO 318
0047006    761.      345 K43=K43+1
0047028    762.      IF (IP.EQ.1) GO TO 348
0047046    763.      GO TO 318
0047046    764.      348 K44=K44+1
0047068    765.      V17=V17+PA
0047078    766.      GO TO 318
0047108    767.      346 K45=K45+1
0047126    768.      IF (IP.EQ.1) GO TO 349
0047143    769.      GO TO 318
0047145    770.      349 K46=K46+1
0047166    771.      V18=V18+PA
0047178    772.      GO TO 318
0047208    773.      347 K47=K47+1
0047228    774.      IF (IP.EQ.1) GO TO 350
0047246    775.      GO TO 318
0047246    776.      350 K48=K48+1
0047266    777.      V19=V19+PA
0047278    778.      GO TO 318
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
004730E    779.      316 K49=K49+1
004732E    780.      IF (IP.EQ.1) GO TO 351
0047343    781.      GO TO 352
0047346    782.      351 K50=K50+1
0047366    783.      V20=V20+PA
0047378    784.      352 IF (ICE.EQ.1) GO TO 353
0047416    785.      IF (ICE.EQ.2) GO TO 354
0047436    786.      IF (ICE.EQ.3) GO TO 355
0047446    787.      GO TO 318
0047456    788.      353 K51=K51+1
0047476    789.      IF (IP.EQ.1) GO TO 356
0047518    790.      GO TO 318
004751E    791.      356 K52=K52+1
0047536    792.      V21=V21+PA
0047548    793.      GO TO 318
0047558    794.      354 K53=K53+1
0047576    795.      IF (IP.EQ.1) GO TO 357
0047616    796.      GO TO 318
0047613    797.      357 K54=K54+1
0047636    798.      V22=V22+PA
0047648    799.      GO TO 318
0047653    800.      355 K55=K55+1
0047676    801.      IF (IP.EQ.1) GO TO 358
0047716    802.      GO TO 318
004771E    803.      358 K56=K56+1
0047738    804.      V23=V23+PA
004774E    805.      GO TO 318
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
0047756    806.      317 K57=K57+1
0047776    807.      IF (IP.EQ.1) GO TO 359
0050016    808.      GO TO 360
0050016    809.      359 K58=K58+1
0050036    810.      V24=V24+PA
0050048    811.      360 IF (ICE.EQ.1) GO TO 361

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0051066    859.   372 IF (IJ.EQ.1) GO TO 376
0051106    860.   1F (IJ.EQ.2) GO TO 377
0051126    861.   1F (IJ.EQ.3) GO TO 378
0051138    862.   1F (IJ.EQ.4) GO TO 379
0051153    863.   1F (IJ.EQ.5) GO TO 380
0051168    864.   1F (IJ.EQ.0) GO TO 381
0051203    865.   GO TO 382
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C          DISTRICT 1 ANALYSIS
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
0051216    866.   376 J17=J17+1
0051226    867.   IF (IP.EQ.1) GO TO 383
0051246    868.   GO TO 384
0051248    869.   383 J18=J18+1
0051266    870.   U4=U4+PA
005127E    871.   384 1F (ICE.EQ.1) GO TO 385
0051316    872.   IF (ICE.EQ.2) GO TO 386
0051338    873.   IF (ICE.EQ.3) GO TO 387
0051346    874.   GO TO 382
0051353    875.   385 J19=J19+1
0051376    876.   IF (IP.EQ.1) GO TO 388
0051416    877.   GO TO 382
0051418    878.   388 J20=J20+1
0051434    879.   U5=U5+PA
0051446    880.   GO TO 382
0051456    881.   386 J21=J21+1
0051476    882.   IF (IP.EQ.1) GO TO 389
0051516    883.   GO TO 382
0051515    884.   389 J22=J22+1
0051536    885.   U6=U6+PA
0051546    886.   GO TO 382
0051556    887.   387 J23=J23+1
0051575    888.   IF (IP.EQ.1) GO TO 390
0051616    889.   GO TO 382
0051615    890.   390 J24=J24+1
0051636    891.   U7=U7+PA
0051646    892.   GO TO 382
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C          DISTRICT 2 ANALYSIS
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
0051656    893.   377 J25=J25+1
0051676    894.   IF (IP.EQ.1) GO TO 391
0051716    895.   GO TO 392
0051716    896.   391 J26=J26+1
0051735    897.   U8=U8+PA
0051746    898.   392 1F (ICE.EQ.1) GO TO 393
0051766    899.   1F (ICE.EQ.2) GO TO 394
0052008    900.   1F (ICE.EQ.3) GO TO 395
0052016    901.   GO TO 382
0052026    902.   393 J27=J27+1
0052048    903.   IF (IP.EQ.1) GO TO 396
0052068    904.   GO TO 382
0052069    905.   396 J28=J28+1
0052108    906.   U9=U9+PA
0052118    907.   GO TO 382
0052126    908.   394 J29=J29+1
0052143    909.   IF (IP.EQ.1) GO TO 397
0052166    910.   GO TO 382

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0052160    911.   397 J30=J30+1
0052208    912.   U10=U10+PA
0052216    913.   GO TO 382
0052223    914.   395 J31=J31+1
0052248    915.   IF (IP.EQ.1) GO TO 398
0052268    916.   GO TO 382
0052268    917.   398 J32=J32+1
0052306    918.   U11=U11+PA
0052316    919.   GO TO 382
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
0052326    920.   378 J33=J33+1
0052346    921.   IF (IP.EQ.1) GO TO 399
0052363    922.   GO TO 400
0052366    923.   399 J34=J34+1
0052406    924.   U12=U12+PA
0052416    925.   400 IF (ICE.EQ.1) GO TO 401
0052438    926.   IF (ICE.EQ.2) GO TO 402
0052453    927.   IF (ICE.EQ.3) GO TO 403
0052468    928.   GO TO 382
0052478    929.   401 J35=J35+1
0052516    930.   IF (IP.EQ.1) GO TO 404
0052533    931.   GO TO 382
0052538    932.   404 J36=J36+1
0052558    933.   U13=U13+PA
0052566    934.   GO TO 382
0052578    935.   402 J37=J37+1
0052618    936.   IF (IP.EQ.1) GO TO 405
0052633    937.   GO TO 382
0052635    938.   405 J38=J38+1
0052658    939.   U14=U14+PA
0052666    940.   GO TO 382
0052676    941.   403 J39=J39+1
0052718    942.   IF (IP.EQ.1) GO TO 406
0052738    943.   GO TO 382
0052738    944.   406 J40=J40+1
0052753    945.   U15=U15+PA
0052768    946.   GO TO 382
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
0052778    947.   379 J41=J41+1
0053018    948.   IF (IP.EQ.1) GO TO 407
0053038    949.   GO TO 408
0053038    950.   407 J42=J42+1
0053058    951.   U16=U16+PA
0053068    952.   408 IF (ICE.EQ.1) GO TO 409
0053103    953.   IF (ICE.EQ.2) GO TO 410
0053126    954.   IF (ICE.EQ.3) GO TO 411
0053138    955.   GO TO 382
0053148    956.   409 J43=J43+1
0053168    957.   IF (IP.EQ.1) GO TO 412
0053208    958.   GO TO 382
0053208    959.   412 J44=J44+1
0053228    960.   U17=U17+PA
0053238    961.   GO TO 382
0053246    962.   410 J45=J45+1

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0053260      963.      IF (IP.EQ.1) GO TO 413
0053306      964.      GO TO 382
0053303      965.      413 J46=J46+1
0053323      966.      U18=U18+PA
0053336      967.      GO TO 382
0053340      968.      411 J47=J47+1
0053366      969.      IF (IP.EQ.1) GO TO 414
0053408      970.      GO TO 382
0053406      971.      414 J48=J48+1
0053428      972.      U19=U19+PA
0053438      973.      GO TO 382
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C          DISTRICT 1 ANALYSIS
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
0053446      974.      380 J49=J49+1
0053468      975.      IF (IP.EQ.1) GO TO 415
0053503      976.      GO TO 416
0053503      977.      415 J50=J50+1
0053526      978.      U20=U20+PA
0053538      979.      416 IF (ICE.EQ.1) GO TO 417
0053556      980.      IF (ICE.EQ.2) GO TO 418
0053573      981.      IF (ICE.EQ.3) GO TO 419
0053606      982.      GO TO 382
0053618      983.      417 J51=J51+1
0053636      984.      IF (IP.EQ.1) GO TO 420
0053658      985.      GO TO 382
0053656      986.      420 J52=J52+1
0053678      987.      U21=U21+PA
0053706      988.      GO TO 382
0053713      989.      418 J53=J53+1
0053738      990.      IF (IP.EQ.1) GO TO 421
0053750      991.      GO TO 382
0053752      992.      421 J54=J54+1
0053776      993.      U22=U22+PA
0054006      994.      GO TO 382
0054016      995.      419 J55=J55+1
0054036      996.      IF (IP.EQ.1) GO TO 422
0054056      997.      GO TO 382
0054058      998.      422 J56=J56+1
0054076      999.      U23=U23+PA
0054106     1000.      GO TO 382
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C          DISTRICT 6 ANALYSIS
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
0054116     1001.      381 J57=J57+1
0054136     1002.      IF (IP.EQ.1) GO TO 423
0054156     1003.      GO TO 424
0054156     1004.      423 J58=J58+1
0054176     1005.      U24=U24+PA
0054203     1006.      424 IF (ICE.EQ.1) GO TO 425
0054228     1007.      IF (ICE.EQ.2) GO TO 426
0054246     1008.      IF (ICE.EQ.3) GO TO 427
0054253     1009.      GO TO 382
0054268     1010.      425 J59=J59+1
0054308     1011.      IF (IP.EQ.1) GO TO 428
0054326     1012.      GO TO 382
0054326     1013.      428 J60=J60+1
0054346     1014.      U25=U25+PA

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005435b	1015.	GO TO 382
005436b	1016.	426 J <sub>01</sub> =J <sub>01</sub> +1
005440b	1017.	IF (IP.EQ.1) GO TO 429
005442b	1018.	GO TO 382
005442b	1019.	429 J <sub>02</sub> =J <sub>02</sub> +1
005444b	1020.	U <sub>26</sub> =U <sub>26</sub> +PA
005445b	1021.	GO TO 382
005446b	1022.	427 J <sub>03</sub> =J <sub>03</sub> +1
005450b	1023.	IF (IP.EQ.1) GO TO 430
005452b	1024.	GO TO 382
005452b	1025.	430 J <sub>04</sub> =J <sub>04</sub> +1
005454b	1026.	U <sub>27</sub> =U <sub>27</sub> +PA
005455b	1027.	382 GO TO 100
005456b	1028.	999 NR=(N2*100)/N1
005462b	1029.	NR1=(N12*100)/N11
005466b	1030.	NR2=(N14*100)/N13
005471b	1031.	NR3=(N16*100)/N15
005475b	1032.	NR4=(N18*100)/N17
005500b	1033.	NR5=(N20*100)/N19
005504b	1034.	NR6=(N22*100)/N21
005507b	1035.	NR7=(N24*100)/N23
005513b	1036.	NR8=(N26*100)/N25
005516b	1037.	NR9=(N28*100)/N27
005522b	1038.	NR10=(N30*100)/N29
005525b	1039.	NR11=(N32*100)/N31
005531b	1040.	NR12=(N34*100)/N33
005534b	1041.	NR13=(N36*100)/N35
005540b	1042.	NR14=(N38*100)/N37
005543b	1043.	NR15=(N40*100)/N39
005547b	1044.	NR16=(N42*100)/N41
005552b	1045.	NR17=(N44*100)/N43
005556b	1046.	NR18=(N46*100)/N45
005561b	1047.	NR19=(N48*100)/N47
005565b	1048.	NR20=(N50*100)/N49
005570b	1049.	NR21=(N52*100)/N51
005574b	1050.	NR22=(N54*100)/N53
005577b	1051.	NR23=(N56*100)/N55
005603b	1052.	NR24=(N58*100)/N57
005606b	1053.	NR25=(N60*100)/N59
005612b	1054.	NR26=(N62*100)/N61
005615b	1055.	NR27=(N64*100)/N63
005621b	1056.	MR= (M2*100)/M1
005624b	1057.	MR1=(M12*100)/M11
005630b	1058.	MR2=(M14*100)/M13
005633b	1059.	MR3=(M15*100)/M15
005637b	1060.	MR4=(M13*100)/M17
005642b	1061.	MR5=(M20*100)/M19
005646b	1062.	MR6=(M22*100)/M21
005651b	1063.	MR7=(M24*100)/M23
005655b	1064.	MR8=(M26*100)/M25
005660b	1065.	MR9=(M28*100)/M27
005664b	1066.	MR10=(M30*100)/M29
005667b	1067.	MR11=(M32*100)/M31
005673b	1068.	MR12=(M34*100)/M33
005676b	1069.	MR13=(M36*100)/M35
005702b	1070.	MR14=(M38*100)/M37
005705b	1071.	MR15=(M40*100)/M39
005711b	1072.	MR16=(M42*100)/M41



005714 <sub>b</sub>	1073.	MR17=(M44*100)/M43
005720 <sub>b</sub>	1074.	MR18=(M46*100)/M45
005725 <sub>b</sub>	1075.	MR19=(M48*100)/M47
005727 <sub>b</sub>	1076.	MR20=(M50*100)/M49
005732 <sub>b</sub>	1077.	MR21=(M52*100)/M51
005736 <sub>b</sub>	1078.	MR22=(M54*100)/M53
005741 <sub>b</sub>	1079.	MR23=(M56*100)/M55
005745 <sub>b</sub>	1080.	MR24=(M58*100)/M57
005750 <sub>b</sub>	1081.	MR25=(M60*100)/M59
005754 <sub>b</sub>	1082.	MR26=(M62*100)/M61
005757 <sub>b</sub>	1083.	MR27=(M64*100)/M63
005763 <sub>b</sub>	1084.	LR=(L2*100)/L1
005766 <sub>b</sub>	1085.	LR1=(L12*100)/L11
005772 <sub>b</sub>	1086.	LR2=(L14*100)/L13
005775 <sub>b</sub>	1087.	LR3=(L16*100)/L15
006014 <sub>b</sub>	1088.	LR4=(L18*100)/L17
006004 <sub>b</sub>	1089.	LR5=(L20*100)/L19
006010 <sub>b</sub>	1090.	LR6=(L22*100)/L21
006013 <sub>b</sub>	1091.	LR7=(L24*100)/L23
006017 <sub>b</sub>	1092.	LR8=(L26*100)/L25
006022 <sub>b</sub>	1093.	LR9=(L28*100)/L27
006026 <sub>b</sub>	1094.	LR10=(L30*100)/L29
006031 <sub>b</sub>	1095.	LR11=(L32*100)/L31
006035 <sub>b</sub>	1096.	LR12=(L34*100)/L33
006044 <sub>b</sub>	1097.	LR13=(L36*100)/L35
006044 <sub>b</sub>	1098.	LR14=(L38*100)/L37
006047 <sub>b</sub>	1099.	LR15=(L40*100)/L39
006053 <sub>b</sub>	1100.	LR16=(L42*100)/L41
006056 <sub>b</sub>	1101.	LR17=(L44*100)/L43
006062 <sub>b</sub>	1102.	LR18=(L46*100)/L45
006065 <sub>b</sub>	1103.	LR19=(L48*100)/L47
006071 <sub>b</sub>	1104.	LR20=(L50*100)/L49
006074 <sub>b</sub>	1105.	LR21=(L52*100)/L51
006100 <sub>b</sub>	1106.	LR22=(L54*100)/L53
006103 <sub>b</sub>	1107.	LR23=(L56*100)/L55
006107 <sub>b</sub>	1108.	LR24=(L58*100)/L57
006112 <sub>b</sub>	1109.	LR25=(L60*100)/L59
006116 <sub>b</sub>	1110.	LR26=(L62*100)/L61
006121 <sub>b</sub>	1111.	LR27=(L64*100)/L63
006125 <sub>b</sub>	1112.	KR=(K2*100)/K1
006130 <sub>b</sub>	1113.	KR1=(K12*100)/K11
006134 <sub>b</sub>	1114.	KR2=(K14*100)/K13
006137 <sub>b</sub>	1115.	KR3=(K16*100)/K15
006143 <sub>b</sub>	1116.	KR4=(K18*100)/K17
006146 <sub>b</sub>	1117.	KR5=(K20*100)/K19
006152 <sub>b</sub>	1118.	KR6=(K22*100)/K21
006155 <sub>b</sub>	1119.	KR7=(K24*100)/K23
006161 <sub>b</sub>	1120.	KR8=(K26*100)/K25
006164 <sub>b</sub>	1121.	KR9=(K28*100)/K27
006170 <sub>b</sub>	1122.	KR10=(K30*100)/K29
006173 <sub>b</sub>	1123.	KR11=(K32*100)/K31
006177 <sub>b</sub>	1124.	KR12=(K34*100)/K33
006202 <sub>b</sub>	1125.	KR13=(K36*100)/K35
006206 <sub>b</sub>	1126.	KR14=(K38*100)/K37
006211 <sub>b</sub>	1127.	KR15=(K40*100)/K39
006215 <sub>b</sub>	1128.	KR16=(K42*100)/K41
006220 <sub>b</sub>	1129.	KR17=(K44*100)/K43
006224 <sub>b</sub>	1130.	KR18=(K46*100)/K45



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0062278 1131. KR19=(K48*100)/K47
0062358 1132. KR20=(K50*100)/K49
0062368 1133. KR21=(K52*100)/K51
0062425 1134. KR22=(K54*100)/K53
0062458 1135. KR23=(K56*100)/K55
0062516 1136. KR24=(K58*100)/K57
0062548 1137. KR25=(K60*100)/K59
0062608 1138. KR26=(K62*100)/K61
0062636 1139. KR27=(K64*100)/K63
0062676 1140. JR=(J2*100)/J1
0062728 1141. JR1=(J12*100)/J11
0062768 1142. JR2=(J14*100)/J13
0063018 1143. JR3=(J16*100)/J15
0063058 1144. JR4=(J18*100)/J17
0063108 1145. JR5=(J20*100)/J19
0063148 1146. JR6=(J22*100)/J21
0063178 1147. JR7=(J24*100)/J23
0063236 1148. JR8=(J25*100)/J25
0063263 1149. JR9=(J28*100)/J27
0063326 1150. JR10=(J30*100)/J29
0063356 1151. JR11=(J32*100)/J31
0063418 1152. JR12=(J34*100)/J33
0063446 1153. JR13=(J36*100)/J35
0063508 1154. JR14=(J38*100)/J37
0063538 1155. JR15=(J40*100)/J39
0063578 1155. JR16=(J42*100)/J41
0063623 1157. JR17=(J44*100)/J43
0063668 1158. JR18=(J46*100)/J45
0063718 1159. JR19=(J48*100)/J47
0063758 1160. JR20=(J50*100)/J49
0064008 1161. JR21=(J52*100)/J51
0064043 1162. JR22=(J54*100)/J53
0064078 1163. JR23=(J56*100)/J55
0064138 1164. JR24=(J58*100)/J57
0064166 1165. JR25=(J60*100)/J59
0064228 1166. JR26=(J62*100)/J61
0064258 1167. JR27=(J64*100)/J63
0064313 1168. NQ=((100*(N2*M2+L2*K2+J2))/N
0064408 1169. SUM=X+Y+Z+V+U
0064468 1170. LL1=(100*(N18*M18+L18*K18+J18))/(N17+M17+L17+K17+J17)
0064608 1171. LL2=(100*(N26*M26+L26*K26+J26))/(N25+M25+L25+K25+J25)
0064743 1172. LL3=(100*(N34*M34+L34*K34+J34))/((N33+M33+L33+K33+J33))
0065108 1173. LL4=(100*(N42*M42+L42*K42+J42))/((N41+M41+L41+K41+J41))
0065248 1174. LL5=(100*(N50*M50+L50*K50+J50))/((N49+M49+L49+K49+J49))
0065408 1175. LL6=(100*(N58*M58+L58*K58+J58))/((N57+M57+L57+K57+J57))
0065548 1176. PRINT 827,SUM
0065623 1177. 827 FORMAT (//,% THE TOTAL PENALTY PAID THIS YEAR IS $X,F8.2)
0065626 1178. PRINT 801,N
0065678 1179. 801 FORMAT (///,5X,%THE TOTAL NUMBER OF CONTRACTS IS $X,2X,I3)
0065678 1180. PRINT 828,NQ
0065746 1181. 828 FORMAT (//,% THE PERCENTAGE OF CONTRACTS IN WHICH PENALTIES WERE PAID THIS YEAR IS $X,2X,I3)
0065748 1182. PRINT 802,N1,NR
0066028 1183. 802 FORMAT (I $1$,%5X,%THE TOTAL NUMBER OF ROAD CONTRACTS FOR THE YEAR
0066028 1183. G IS $X,2X,I3,%5X,%PERCENT OF ROAD CONTRACTS IN WHICH PENALTIES WERE PAID IS $X,2X,I3)
0066028 1184. PRINT 803,NR1,NR2,NR3
0066118 1185. 803 FORMAT (///,5X,%PERCENT OF CITY ROAD CONTRACTS IN WHICH PENALTIES

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C WERE PAID IS\*,2X,I3,/,5X,% PERCENT OF COUNTY ROAD CONTRACTS IN WHICH PENALTIES WERE PAID IS\*,2X,I3,/,5X,% PERCENT OF STATE ROAD CONTRACTS IN WHICH PENALTIES WERE PAID IS\*,2X,I3)

006611b 1186. PRINT 804,N17,N25,N33,N41,N49,N57,NR4,NR8,NR12,NR16,NR20,NR24,CN19,N27,N35,N43,N51,N59,NR5,NR9,NR13,NR17,NR21,NR25,N21,N29,CN37,N45,N53,N61,NR6,NR10,NR14,NR18,NR22,NR26,N23,N31,N39,N47,CN55,N63,NR7,NR11,NR15,NR19,NR23,NR27

006675b 1187. 804 FORMAT (//,,20X,ROAD CONTRACTS FOR THE DISTRICTS#,//,29X,#01#,C7X,#D2#,7X,#03#,7X,#04#,7X,#05#,7X,#06#,/,# TOTAL NUMBER#,15X,C13,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,/,# PERCENT WITH PENALTIES#,C5X,I3,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,/,# NUMBER WITH CITY EGR#,C7X,I3,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,/,# PERCENT PENALTY\*CITY EGR#,C3X,I3,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,/,# NUMBER WITH COUNTY EGR#,C5X,I3,6X,C13,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,/,# PERCENT PENALTY\*COUNTY EGR#,1X,I3,C6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,/,# NUMBER WITH STATE EGR#,6X,I3,C6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,/,# PERCENT PENALTY\*STATE EGR#,2X,C13,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,/,#

006675b 1188. PRINT 805,X,X1,X2,X3

0067056 1189. 805 FORMAT (//,,5X,%TOTAL PENALTY FOR ROAD CONTRACTS IS\*,2X,F8.2,C/,5X,%TOTAL PENALTY FOR CITY ROAD CONTRACTS IS\*,2X,F8.2,/,5X,C%TOTAL PENALTY FOR COUNTY ROAD CONTRACTS IS\*,2X,F8.2,/,5X,%TOTAL C PENALTY FOR STATE ROAD CONTRACTS IS\*,2X,F8.2)

0067056 1190. PRINT 806,X5,X9,X13,X17,X21,X25,X6,X10,X14,X18,X22,X26,X7,X11,CX15,X19,X23,X27

006733b 1191. 806 FORMAT (//,,28X,%PENALTY AMOUNTS#,//,19X,#01#,8X,#02#,8X,#03#,6X,C#04#,8X,#05#,6X,#06#,/,# ROAD\*CITY#,6X,F8.2,X,F8.2,X,F8.2,CF8.2,X,F8.2,/,# ROAD\*COUNTY#,4X,F8.2,X,F8.2,X,F8.2,X,F8.2,X,CF8.2,X,F8.2,/,# ROAD\*STATE#,5X,F8.2,X,F8.2,X,F8.2,X,F8.2,CX,F8.2)

006733b 1192. PRINT 807,M1,MR

006741b 1193. 807 FORMAT ( #1#,%5X,%THE TOTAL NUMBER OF BRIDGE CONTRACTS FOR THE YEAR C IS\*,2X,I3,/,5X,%PERCENT OF BRIDGE CONTRACTS IN WHICH PENALTIES C WERE PAID IS\*,2X,I3)

006741b 1194. PRINT 808,MR1,MR2,MR3

006750b 1195. 808 FORMAT (//,,5X,%PERCENT OF CITY BRIDGE CONTRACTS IN WHICH PENALTIES WERE PAID IS\*,2X,I3,/,5X,%PERCENT OF COUNTY BRIDGE CONTRACTS IN WHICH PENALTIES WERE PAID IS\*,2X,I3,/,5X,%PERCENT OF STATE BRIDGE C CONTRACTS IN WHICH PENALTIES WERE PAID IS\*,2X,I3)

006750b 1196. PRINT 809,M17,M25,M33,M41,M49,M57,MR4,MR8,MR12,MR16,MR20,MR24,CM19,M27,M35,M43,M51,M59,MR5,MR9,MR13,MR17,MR21,MR25,M21,M29,CM37,M45,M53,M61,MR6,MR10,MR14,MR18,MR22,MR26,M23,M31,M39,M47,CM55,M63,MR7,MR11,MR15,MR19,MR23,MR27

007034b 1197. 809 FORMAT (//,,18X,%BRIDGE CONTRACTS FOR THE DISTRICTS#,//,29X,#01#,C7X,#D2#,7X,#03#,7X,#04#,7X,#05#,7X,#06#,/,# TOTAL NUMBER#,15X,C13,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,/,# PERCENT WITH PENALTIES#,C5X,I3,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,/,# NUMBER WITH CITY EGR#,C7X,I3,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,/,# PERCENT PENALTY\*CITY EGR#,C3X,I3,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,/,# NUMBER WITH COUNTY EGR#,C5X,I3,6X,C13,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,/,# PERCENT PENALTY\*COUNTY EGR#,1X,I3,C6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,/,# NUMBER WITH STATE EGR#,6X,I3,C6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,/,# PERCENT PENALTY\*STATE EGR#,2X,C13,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,6X,I3,/,#

007034b 1198. PRINT 810,Y,Y1,Y2,Y3

007044b 1199. 810 FORMAT (//,,5X,%TOTAL PENALTY FOR BRIDGE CONTRACTS IS\*,2X,F8.2,C/,5X,%TOTAL PENALTY FOR CITY BRIDGE CONTRACTS IS\*,2X,F8.2,/,5X,C%TOTAL PENALTY FOR COUNTY BRIDGE CONTRACTS IS\*,2X,F8.2,/,5X,%TOTAL







0073326 1217. 814 FORMAT (//,/,1X,FROAD\* SURFACING CONTRACTS FOR THE DISTRICTS, //,/  
 C3X,F1U1,ZX,,Z,X,F02X,7X,F03X,7X,F04X,7X,F05X,7X,F06X,/,# TOTAL NUMBER,  
 C15X,13,6X,13,0X,13,0X,13,6X,13,6X,13,0X,13,/,# PERCENT WITH PENALTIES,  
 CX,13,6X,13,0X,13,6X,13,0X,13,6X,13,6X,13,0X,13,/,# NUMBER WITH CITY EGFX,7X,13  
 G,0,6X,13,6X,13,0X,13,0X,13,6X,13,0X,13,0X,13,/,# PERCENT PENALTY-CITY EGFX,3X,13  
 G,0,6X,13,6X,13,0X,13,0X,13,6X,13,0X,13,0X,13,/,# NUMBER WITH COUNTY EGFX,13  
 CX,13,6X,13,0X,13,6X,13,0X,13,6X,13,0X,13,0X,13,/,# PERCENT PENALTY-COUNTY EGFX,1X,13  
 G,0,6X,13,6X,13,0X,13,0X,13,6X,13,0X,13,0X,13,/,# NUMBER WITH STATE EGFX,0X,13,6X  
 G,13,6X,13,0X,13,6X,13,6X,13,6X,13,0X,13,6X,13,/,# PERCENT PENALTY-STATE EGFX,2X,13,0X  
 G,13,0X,13,6X,13,6X,13,6X,13,6X,13)  
 PRINT 820,U,V1,V2,V3,V4  
 0073326 1218. 820 FORMAT (//,/,5X,#TOTAL PENALTY FOR ROAD\* SURFACING CONTRACTS ISX,2X  
 C,F8,2/,/,5X,#TOTAL PENALTY FOR CITY ROAD\* SURFACING CONTRACTS ISX,2X  
 C,F8,2/,/,5X,#TOTAL PENALTY FOR COUNTY ROAD\* SURFACING CONTRACTS ISX,2X  
 G2X,F8,2,/,#X,#TOTAL PENALTY FOR STATE ROAD\* SURFACING CONTRACTS ISX,2X  
 0073425 1219. 821 PRINT 821,V5,V9,V13,V17,V21,V25,V8,V10,V14,V18,V22,V26,V7,V11,  
 CV15,V19,V23,V27  
 0073706 1220. 821 FORMAT (//,/,28X,#PENALTY AMOUNTS,/,30X,F01X,7X,F02X,0X,F03X,8X,  
 C,F04X,7X,F05X,7X,F06X,/,# ROAD\* SURFACING\* CITY#,5X,F8,2,X,F8,2,X,FH,2,  
 G2,X,F8,2,X,F8,2,X,F8,2,/,# ROAD\* SURFACING\* COUNTY#,4X,F3,2,X,FH,2,  
 CX,F8,2,X,FH,2,X,F8,2,X,F8,2,/,# ROAD\* SURFACING\* STATE#,0X,FH,2,X,FH,2  
 G8,2,X,F8,2,X,F8,2,X,F8,2,X,F8,2,X,F8,2,1  
 PRINT 822,J1,JR  
 0073706 1222. 822 FORMAT (//,1X,F5X,#THE TOTAL NUMBER OF ROAD\* MAINTENANCE CONTRACTS FOR  
 THE YEAR ISX,2X,13,/,5X,#PERCENT OF ROAD\* MAINTENANCE CONTRACTS IN  
 WHICH PENALTIES WERE PAID ISX,2X,[3])  
 0073766 1223. 823 PRINT 823,J1,JR1,JR2,JR3  
 0074053 1224. 823 FORMAT (//,/,5X,#PERCENT OF CITY ROAD\* MAINTENANCE CONTRACTS IN WHICH  
 PENALTIES WERE PAID ISX,2X,13,/,5X,#PERCENT OF COUNTY ROAD\* MAIN  
 TENANCE CONTRACTS IN WHICH PENALTIES WERE PAID ISX,2X,13,/,5X,#PER  
 CENT OF STATE ROAD\* MAINTENANCE CONTRACTS IN WHICH PENALTIES WERE PAID ISX,2X,13)  
 0074056 1225. 824 PRINT 824,J17,J25,J33,J41,J49,J57,J64,JR8,JR12,JR16,JR22,JR24,  
 CJ13,J27,J35,J43,J51,J59,JP5,JR3,JR13,JR17,JR21,JR25,J21,J29,  
 CJ37,J45,J53,J61,J68,JR1,JR10,JR14,JR18,JR22,JR26,J23,J31,J39,J47,  
 G55,J63,J77,JR11,JR15,JR19,JR23,JR27  
 0074716 1226. 824 FORMAT (//,/,1X,FROAD\* MAINTENANCE CONTRACTS FOR THE DISTRICTS, //  
 C,29X,F01X,7X,F02X,7X,F03X,7X,F04X,7X,F05X,7X,F06X,/,# TOTAL NUMBER  
 C#,13,6X,13,6X,13,6X,13,6X,13,6X,13,6X,13,6X,13,/,# PERCENT WITH PENALTIES,  
 G,9X,13,0X,13,0X,13,0X,13,6X,13,0X,13,6X,13,0X,13,/,# NUMBER WITH CITY EGFX,7X,  
 C13,0X,13,6X,13,6X,13,6X,13,6X,13,6X,13,0X,13,/,# PERCENT PENALTY-CITY EGFX,3X,  
 C13,0X,13,6X,13,6X,13,0X,13,6X,13,6X,13,0X,13,/,# NUMBER WITH COUNTY EGFX,5X,13  
 G,0,X,13,6X,13,0X,13,6X,13,0X,13,6X,13,0X,13,0X,13,/,# PERCENT PENALTY-COUNTY EGFX,1X,  
 C13,0X,13,6X,13,0X,13,6X,13,6X,13,0X,13,0X,13,/,# NUMBER WITH STATE EGFX,0X,13  
 G,6X,13,6X,13,0X,13,6X,13,6X,13,0X,13,0X,13)  
 PRINT 825,U,U1,U2,U3  
 0075016 1227. 825 PRINT 825,V5,V9,V13,V17,V21,V25,U6,U10,U14,U18,U22,U26,U7,J11,  
 G2X,F8,2,/,5X,#TOTAL PENALTY FOR CITY ROAD\* MAINTENANCE CONTRACTS ISX,2X  
 C,F8,2,/,5X,#TOTAL PENALTY FOR COUNTY ROAD\* MAINTENANCE CONTRACTS ISX,2X  
 G2X,F8,2,/,5X,#TOTAL PENALTY FOR STATE ROAD\* MAINTENANCE CONTRACTS ISX,2X  
 GACTS ISX,2X,F8,2,1  
 0075016 1228. 826 PRINT 826,U,J5,J9,U13,J17,U21,U25,U6,U10,U14,U18,U22,U26,U7,J11,  
 CU15,U19,U23,U27  
 0075276 1229. 826 FORMAT (//,/,28X,#PENALTY AMOUNTS,/,30X,F01X,8X,F02X,8X,F03X,7X,  
 C,F04X,7X,F05X,7X,F06X,/,# ROAD\* MAINTENANCE\* CITY#,5X,F8,2,X,F8,2,X,FH,2  
 G,13,0X,13,6X,13,0X,13,6X,13,0X,13,6X,13,0X,13,0X,13,/,# PERCENT PENALTY-STATE EGFX,2X,13,0X



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C8.2,X,F8.2,X,F8.2,X,F8.2,/,F ROAD+MAINTENANCE+COUNTY+,X,F8.2,X,F  
C8.2,X,F8.2,X,F8.2,X,F8.2,X,F8.2,/,F ROAD+MAINTENANCE+STATE+,5X,F8  
C+2,X,F8.2,X,F8.2,X,F3.2,X,F8.2,X,F8.2)  
0075276 1232. PRINT 829,LL1,LL2,LL3,LL4,LL5,LL6  
0075415 1233. 829 FORMAT (1X,5X,ZOVERALL PENALTY PERCENTAGE ,BREAKDOWN BY DISTRICTS  
C/,//,5X,2D12,5X,2D2F,5X,2D3F,5X,2D4F,5X,2D5F,5X,2D6F,2D7,13,4X,13  
C,4X,13,4X,13,4X,13,4X,13)  
0075416 1234. STOP  
007543E 1235. END  
D* * * * * * * * * * * * * * * * * * * * * * * * * * *  
C* * * * * * * * * * * * * * * * * * * * * * * * * * * ANALYSIS FOR 1973  
C* * * * * * * * * * * * * * * * * * * * * * * * * * *
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## Appendix B



## Appendix B

## COMPUTER PROGRAM OUTPUT

CONTRACTS WITH PENALTIES	PENALTY AMOUNT
R#08744	1231.53
R#08937	1979.34
R#08955	712.25
R#09060	287.04
R#09209	74.12
R#09440	274.23
R#09553	314.46
R#09581	65.60
R#09586	610.46
R#09621	70.03
R#09732	794.02
R#09831	372.08
R#09875	380.60
R#09878	381.29
R#09879	43.78
R#09906	55.16
R#09930	62.02
R#10092	181.64
R#10198	129.81
R#10246	22.43
R#09543	532.09
R#09568	1068.71
R#09427	522.22
R#09357	95.30
R#10127	19.84
R#09888	138.49
R#09880	162.21
R#09356	166.69
R#10090	22.06
R#09971	24.28



R*09762	24.82
R*09766	196.18
R*09505	699.68
B*09912	24.72
B*09514	327.18
B*09820	39.71
B*08840	49.69
B*09941	34.04
B*10131	154.18
B*09925	53.63
B*09750	879.43
B*09486	72.07
B*09377	12.82
B*08836	360.55
B*08877	6245.05
B*09954	23.09
B*09488	22.23
B*09425	275.14
B*09866	97.22
B*09755	376.93
B*09658	17.29
B*09660	38.27
RT*09897	15.60
RT*10163	19.88
RT*09695	403.23
TX*09433	1896.96
TX*09432	2536.52
TX*09367	1474.72
TX*09074	773.51
RT*10239	26.20



RT*09841	63.81
RT*09834	1583.00
RT*09833	684.90
RS*10055	15.16
RS*10056	26.14
RS*09990	42.77
RS*09992	25.75
RS*10175	12.94
RS*10047	328.40
RS*09982	56.73
RS*10044	665.24
RS*09807	149.38
RM*10038	271.89
RM*10039	47.45
RM*10037	22.73

THE TOTAL PENALTY PAID THIS YEAR IS \$32272.57

THE TOTAL NUMBER OF CONTRACTS IS 355

THE PERCENTAGE OF CONTRACTS IN WHICH PENALTIES WERE PAID THIS YEAR IS 21



THE TOTAL NUMBER OF ROAD CONTRACTS FOR THE YEAR IS 34  
 PERCENT OF ROAD CONTRACTS IN WHICH PENALTIES WERE PAID IS 35

PERCENT OF CITY ROAD CONTRACTS IN WHICH PENALTIES WERE PAID IS 54  
 PERCENT OF COUNTY ROAD CONTRACTS IN WHICH PENALTIES WERE PAID IS 33  
 PERCENT OF STATE ROAD CONTRACTS IN WHICH PENALTIES WERE PAID IS 32

#### ROAD CONTRACTS FOR THE DISTRICTS

	01	02	03	04	05	06
TOTAL NUMBER	13	15	13	14	22	17
PERCENT WITH PENALTIES	38	26	59	21	31	29
NUMBER WITH CITY EGR	1	4	2	3	1	0
PERCENT PENALTY*CITY EGR	100	50	100	33	0	0
NUMBER WITH COUNTY EGR	3	1	1	1	1	0
PERCENT PENALTY*COUNTY EGR	0	0	100	0	0	0
NUMBER WITH STATE EGR	12	10	10	11	20	17
PERCENT PENALTY*STATE EGR	33	26	60	18	35	29

TOTAL PENALTY FOR ROAD CONTRACTS IS 12014.45  
 TOTAL PENALTY FOR CITY ROAD CONTRACTS IS 1511.23  
 TOTAL PENALTY FOR COUNTY ROAD CONTRACTS IS 55.15  
 TOTAL PENALTY FOR STATE ROAD CONTRACTS IS 10448.01

#### PENALTY AMOUNTS

	01	02	03	04	05	06
ROAD*CITY	22.06	300.70	1166.10	22.43	0	0
ROAD*COUNTY	0	0	55.16	0	0	0
ROAD*STATE	944.96	186.53	2943.39	561.27	4517.27	1294.59



THE TOTAL NUMBER OF BRIDGE CONTRACTS FOR THE YEAR IS 107  
 PERCENT OF BRIDGE CONTRACTS IN WHICH PENALTIES WERE PAID IS 17

PERCENT OF CITY BRIDGE CONTRACTS IN WHICH PENALTIES WERE PAID IS 0  
 PERCENT OF COUNTY BRIDGE CONTRACTS IN WHICH PENALTIES WERE PAID IS 21  
 PERCENT OF STATE BRIDGE CONTRACTS IN WHICH PENALTIES WERE PAID IS 17

#### BRIDGE CONTRACTS FOR THE DISTRICTS

	D1	D2	D3	D4	D5	D6
TOTAL NUMBER	11	24	15	23	17	17
PERCENT WITH PENALTIES	36	12	46	4	11	11
NUMBER WITH CITY EGR	0	0	0	0	0	0
PERCENT PENALTY*CITY EGR	0	0	0	0	0	0
NUMBER WITH COUNTY EGR	5	5	1	1	5	2
PERCENT PENALTY*COUNTY EGR	40	20	100	0	0	0
NUMBER WITH STATE EGR	6	19	14	22	12	15
PERCENT PENALTY*STATE EGR	33	10	42	4	16	13

TOTAL PENALTY FOR BRIDGE CONTRACTS IS 9103.24  
 TOTAL PENALTY FOR CITY BRIDGE CONTRACTS IS 0  
 TOTAL PENALTY FOR COUNTY BRIDGE CONTRACTS IS 229.79  
 TOTAL PENALTY FOR STATE BRIDGE CONTRACTS IS 8873.45

#### PENALTY AMOUNTS

	D1	D2	D3	D4	D5	D6
BRIDGE*CITY	0	0	0	0	0	0
BRIDGE*COUNTY	135.49	22.23	72.07	0	0	0
BRIDGE*STATE	394.22	298.23	7705.66	34.04	89.40	351.90



THE TOTAL NUMBER OF ROAD\*TRAFFIC CONTRACTS FOR THE YEAR IS 36  
 PERCENT OF ROAD\*TRAFFIC CONTRACTS IN WHICH PENALTIES WERE PAID IS 30

PERCENT OF CITY ROAD\*TRAFFIC CONTRACTS IN WHICH PENALTIES WERE PAID IS 72  
 PERCENT OF COUNTY ROAD\*TRAFFIC CONTRACTS IN WHICH PENALTIES WERE PAID IS 0  
 PERCENT OF STATE ROAD\*TRAFFIC CONTRACTS IN WHICH PENALTIES WERE PAID IS 12

## ROAD\*TRAFFIC CONTRACTS FOR THE DISTRICTS

	01	02	03	04	05	06
TOTAL NUMBER	4	3	12	8	4	5
PERCENT WITH PENALTIES	25	100	50	12	0	0
NUMBER WITH CITY EGR	2	2	4	2	1	0
PERCENT PENALTY*CITY EGR	50	100	100	50	0	0
NUMBER WITH COUNTY EGR	0	0	0	0	0	0
PERCENT PENALTY*COUNTY EGR	0	0	0	0	0	0
NUMBER WITH STATE EGR	2	1	8	6	3	5
PERCENT PENALTY*STATE EGR	0	100	25	0	0	0

TOTAL PENALTY FOR ROAD\*TRAFFIC CONTRACTS IS 9490.33  
 TOTAL PENALTY FOR CITY ROAD\*TRAFFIC CONTRACTS IS 7547.29  
 TOTAL PENALTY FOR COUNTY ROAD\*TRAFFIC CONTRACTS IS 0  
 TOTAL PENALTY FOR STATE ROAD\*TRAFFIC CONTRACTS IS 1943.04

## PENALTY AMOUNTS

	01	02	03	04	05	06
ROAD*TRAFFIC*CITY	684.90	1658.81	5187.98	15.60	0	0
ROAD*TRAFFIC*COUNTY	0	0	0	0	0	0
ROAD*TRAFFIC*STATE	0	26.20	1916.84	0	0	0



THE TOTAL NUMBER OF ROAD-SURFACING CONTRACTS FOR THE YEAR IS 75  
 PERCENT OF ROAD-SURFACING CONTRACTS IN WHICH PENALTIES WERE PAID IS 11

PERCENT OF CITY ROAD-SURFACING CONTRACTS IN WHICH PENALTIES WERE PAID IS 0  
 PERCENT OF COUNTY ROAD-SURFACING CONTRACTS IN WHICH PENALTIES WERE PAID IS 0  
 PERCENT OF STATE ROAD-SURFACING CONTRACTS IN WHICH PENALTIES WERE PAID IS 11

#### ROAD-SURFACING CONTRACTS FOR THE DISTRICTS

	01	02	03	04	05	06
TOTAL NUMBER	13	12	8	13	14	16
PERCENT WITH PENALTIES	19	25	0	23	7	0
NUMBER WITH CITY EGR	0	0	0	0	0	0
PERCENT PENALTY*CITY EGR	0	0	0	0	0	0
NUMBER WITH COUNTY*EGR	0	0	0	0	0	0
PERCENT PENALTY*COUNTY EGR	0	0	0	0	0	0
NUMBER WITH STATE EGR	13	12	8	13	14	16
PERCENT PENALTY*STATE EGR	19	25	0	23	7	0

TOTAL PENALTY FOR ROAD-SURFACING CONTRACTS IS 1322.47  
 TOTAL PENALTY FOR CITY ROAD-SURFACING CONTRACTS IS 0  
 TOTAL PENALTY FOR COUNTY ROAD-SURFACING CONTRACTS IS 0  
 TOTAL PENALTY FOR STATE ROAD-SURFACING CONTRACTS IS 1322.47

#### PENALTY AMOUNTS

	01	02	03	04	05	06
ROAD-SURFACING*CITY	0	0	0	0	0	0
ROAD-SURFACING*COUNTY	0	0	0	0	0	0
ROAD-SURFACING*STATE	814.62	398.03	0	94.66	15.16	0



THE TOTAL NUMBER OF ROAD-MAINTENANCE CONTRACTS FOR THE YEAR IS 42  
 PERCENT OF ROAD-MAINTENANCE CONTRACTS IN WHICH PENALTIES WERE PAID IS 7

PERCENT OF CITY ROAD-MAINTENANCE CONTRACTS IN WHICH PENALTIES WERE PAID IS 0  
 PERCENT OF COUNTY ROAD-MAINTENANCE CONTRACTS IN WHICH PENALTIES WERE PAID IS 0  
 PERCENT OF STATE ROAD-MAINTENANCE CONTRACTS IN WHICH PENALTIES WERE PAID IS 7

#### ROAD-MAINTENANCE CONTRACTS FOR THE DISTRICTS

	01	02	03	04	05	06
TOTAL NUMBER	2	6	9	7	8	10
PERCENT WITH PENALTIES	0	16	22	0	0	0
NUMBER WITH CITY EGR	0	0	6	9	0	0
PERCENT PENALTY-CITY EGR	0	0	0	0	0	0
NUMBER WITH COUNTY EGR	0	0	0	0	0	0
PERCENT PENALTY-COUNTY EGR	0	0	0	0	0	0
NUMBER WITH STATE EGR	2	6	9	7	8	10
PERCENT PENALTY-STATE EGR	0	16	22	0	0	0

TOTAL PENALTY FOR ROAD-MAINTENANCE CONTRACTS IS 342.07  
 TOTAL PENALTY FOR CITY ROAD-MAINTENANCE CONTRACTS IS 0  
 TOTAL PENALTY FOR COUNTY ROAD-MAINTENANCE CONTRACTS IS 0  
 TOTAL PENALTY FOR STATE ROAD-MAINTENANCE CONTRACTS IS 342.07

#### PENALTY AMOUNTS

	01	02	03	04	05	06
ROAD-MAINTENANCE-CITY	0	0	0	0	0	0
ROAD-MAINTENANCE-COUNTY	0	0	0	0	0	0
ROAD-MAINTENANCE-STATE	0	22.73	319.34	0	0	0



## OVERALL PENALTY PERCENTAGE BREAKDOWN BY DISTRICTS

D1	D2	D3	D4	D5	D6
27	23	42	12	15	10







## Appendix C

ERRATA SHEETS FOR THE INDIANA STATE HIGHWAY COMMISSION 1970 CONSTRUCTIONRECORD GUIDE FOR ROAD, BRIDGE, MAINTENANCE, AND TRAFFIC CONTRACTS

## Explanation Sheet 1b

Quantity in the first paragraph is misspelled.

## Page 1-1

In the volume of cut column, the 118 should be 119.

## Page 1A-1

In the % deviation column, the 0 for Station 7 should be +1.  
The algebraic total should be +13.  
The average should be +1.

## Page 1A-2

The quantity on plans should be 98766.  
The difference should be -129.

## Page 3

The quantity placed should be 20243.  
The overrun quantity should be 4846.  
The overrun cost should be \$2907.60.

## Page 3-1

The sum of end areas for stations 33+00 and 33+50 should be 1871.  
The volume of cut for these stations should be 1732.  
The total cut should be 20243.

## Explanation Sheet 6a

In the second paragraph, if in the last line is misspelled.

## Page 6

For structure number 16, the remarks column should read "See p. 70."

## Page 6-1

On the bottom drawing, the 4.5' measurement should be 3.0'. A new dimension should be added to show 1.5' of cover.  
Beside the bottom drawing, both lines should read "from table 006."

## Page 6-2

The line below the drawing should read "From Table 003."



- Page 7-1** In the summary, the curb and gutter removal should be item 9.  
In the heading, the contract number should be I-0000 and the item number should be 7 & 9.
- Page 11-1** For day 19, the lineal feet laid should be 1060. For day 22, the lineal feet laid should be 700.
- Page 14-1** For day 17, the lineal feet laid should be 5100. For day 18, the lineal feet laid should be 5100. For day 29, the lineal feet laid should be 10200.
- Page 16-1** For the first course, the lineal feet laid should be 1530. This is also true for the second and third courses.
- Page 17-2** The top 10 feet of the sketch should be labeled H.
- Page 28-2** Between stations 50+00 and 52+80, the average depth should be 4.25.
- Page 31-1** The bottom toewall calculation should total to 122.8.  
The sum of the toewall areas will then be 148.8.  
The grand total area above the summary block should be 380.8.
- Page 41-1** In both road portion calculations, the weight should be 2237 and not 2230.
- Page 53-2** The total of the length put in leads column should be 314.1.
- Page 59** The last line should read "on I.C. 626 on p. 73."
- Page 61** After the last line, add "Addition approved on I.C. 626 on p. 73."
- Page 62** In the second to the last line, maintenance is misspelled.
- Page 63-3** The peat excavation unit price should be \$0.60.  
The peat excavation quantity increase should be 4846.



- Page 63-3 cont'd.
- The peat excavation amount increase should be \$2907.60.  
The peat excavation % change should be +31%.  
The total amount increase should be \$68615.00.  
The total estimated cost should be \$15242.00.  
In the top paragraph, the fourth line should read "sheet 63-4."
- Page 63-4
- For peat excavation, the final quantity should be 20243.  
For peat excavation, the overrun should be 4846.
- Page 65-1
- The % of change for item 17 should be -9%.
- Page 65-2
- In the middle of the page, the statement should read "To pps. 17-1 & 65-1."
- Page 66
- The specification article referred to should be 715.12.
- Page 66-1
- The specification article referred to should be 715.12.
- Page 70
- For structure 14, the error in plan quantity should be +30.  
For structure 14, the net change regular portion should be +23.  
Item 6 quantity increase should be 23.  
Item 6 amount increase should be \$92.00.  
Total increase amount should be \$92.00.  
The estimated cost should be \$28.00.
- Page 71
- The first line in the second paragraph should read "on sheet 10-3."  
At the bottom of the table, does and decreased should be marked out.
- Page 72
- The last line of the paragraph should read "Extra Work Agreement on p. 67-1."
- Page 74
- For item 3, the final estimate quantity should be 20243.  
For item 3, the final estimate amount should be \$12145.80.  
For item 3, the overrun quantity should be 4846.  
For item 3, the overrun amount should be \$2907.60.



Page 77

The final estimate amount should be \$475911.79.  
The overrun amount should be \$86157.84.  
The net overrun should be \$22478.29.  
The net overrun percentage should be 4.957%.

Page 78

For item 3, the final estimate quantity should be 20243.  
For item 3, the final estimate amount should be \$12145.80.  
For item 3, the overrun quantity should be 4846.  
For item 3, the overrun amount should be \$2907.60.

Page 80

The total original estimate amount should be \$405541.85.  
The total final estimate amount should be \$425947.74.  
The overrun total amount should be \$83361.44.  
The net overrun should be \$20405.89.  
The net overrun percentage should be 5.032%.

Table 107

For D=1.8, V=0.0659.

Index

Accuracy misspelled on lines 3 and 4 of the first page.  
Surface misspelled on line 20 of the first page.  
Theoretical misspelled on lines 22 and 23 of the third page.





COVER DESIGN BY ALDO GIORGINI